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The American GAS LIGHT JOURNAL.

(ILLUSTRATED.)

DEVOTED TO THE INTERESTS OF

ILLUMINATION, HEATING, MECHANICAL, CHEMICAL

AND

GENERAL SCIENCE.

VOLUME LXIX.

(FORTIETH YEAR.)

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[OFFICIAL NOTICE.]

Sixth Annual Meeting, Pacific Coast Gas Association.

OFFICE OF THE SECRETARY, OAKLAND, CAL., June 6, 1898.

The sixth annual convention of the Pacific Coast Gas Association, Mr. F. H. Eichbaum, President, will be held in San Francisco, on Tuesday and Wednesday, July 19 and 20, 1898, in the office building of the San Francisco Gas and Electric Company; morning sessions, from 10:15 to 12:30; afternoon sessions, 2 to 4:30. The Board of Directors will meet on Monday, July 18, at 8 P.M., at headquarters, which are hereby established at office of Mr. E. C. Jones, Chief Engineer San Francisco Gas and Electric Company, No. 413 Post street.

Copies of all papers, questions and applications for membership must be mailed to Secretary prior to July 18. Members to whom questions are assigned are requested to send answers promptly.

Papers will be submitted by the following members, on subjects to be announced:

E. C. Jones, San Francisco, Cal.; C. O. Poole, San Francisco, Cal.; John L. Howard, San Francisco, Cal.; O. M. Gregory, San Jose, Cal.; F. Foveaux, San Francisco, Cal.; John A. Britton, Oakland, Cal.; W. M. Parker, Bellingham Bay, Wash.; A. Gutsch, Fresno, Cal. In addition to his address as President, Mr. Eichbaum will continue his "Reminiscences."

The question of the change of name of the Association, from that of the Pacific Coast Gas Association to that of the Pacific Coast Gas and Electric Association, will come up for final action.

Mr. George H. Hollidge, of Merced, Cal., has charge of "Wrinkles," and Mr. John Clement, of Red Bluff, Cal., is directing the "Experiences." It is hoped the members will contribute liberally to both of these departments.

An excursion is arranged for Thursday, July 21, particulars of which will be hereafter announced.

The Secretary has on hand a number of bound copies of the "Proceedings," which are purchasable at $2 per copy.

JOHN A. BRITTON, Secretary.

[OFFICIAL NOTICE.]

Wrinkle Department, Pacific Coast Gas Association.

MERCED, CAL., March 11, 1898.

To the Members of the Pacific Coast Gas Association: At the last meeting of the Pacific Coast Gas Association to me was delegated the duty of collecting and presenting any matter, in the shape of original ideas or special devices, which may come under the head of "Wrinkles," to be presented in proper form for the benefit of the Association at the next regular assembly.

Many of our members having charge of gas plants on the Coast have many plans, that are practical, handy and labor-saving, which many others by force of circumstances have never seen, but who, on presentation of the device, drawn and described, or through the medium of our official organ (the AMERICAN GAS LIGHT JOURNAL), would gladly embrace the opportunity, and put into practice a plan very beneficial—which perhaps had been in use in some obscure place many years, used

exclusively by one man—that would, when given daylight, benefit the whole gas fraternity.

On reading this communication, please see if you have not forgotten something in the shape of a "Wrinkle," that is doing good service in your works, that would be of great importance to the Association. Your answer to this will greatly oblige.

GEORGE H. HOLLIDGE,
Editor "Wrinkle" Department.

BRIEFLY TOLD.

THE JULY CONVENTION OF THE PACIFIC COAST GAS ASSOCIATION.—The sixth convention of the Pacific Coast Gas Association will be held in about a fortnight, and all signs of the day go to paint a right good assembling picture. As Mr. Eichbaum (the President of the Association) has lost none of the pluck which has advanced him to the leadership of the Coast gas men, and as our further belief is that Secretary Britton is strong enough to think that gas is bright to the point of vanquishing every other system of modern illumination on the Coast or elsewhere, where lighting works from central stations are operated for profit, we have small doubt that an outcome of the meeting will be the negativing of the proposition to alter the present title of the Association to that of the Pacific Coast Gas and Electric Association. It is true that the San Francisco Gas Company has seen fit to indulge in the supply of electric currents for any purpose that its customers saw profit for them in their use, but as the main purpose of any company's business is to conduct that business for fair profit to itself, we may be excused for asserting that, on the Pacific Coast as elsewhere, the profit in the lighting business from combined central stations is found rather in the gas than in the electric end of such supply. As a cart must have a horse before the cart can move or be of service, it looks to us that, judging from the relative profits of gas and electric lighting in the large city of San Francisco, the gas horse has been doing pretty well in moving the electric cart in San Francisco. If such is the case, and we are satisfied that so it is, there is little probability that the title of the Association will be changed. Whether or not the Association elects to be rebaptized the fact remains that the Pacific's next meeting is sure to be interesting from a technical standpoint, since the programme of the convention is well lined with topics, the discussion of which can prove only of interest to those engaged in spreading the light. A week from now we hope to give the subjects on which the named authors in the official programme will treat, and our present information is that gas will, in the paper presentation, hold that rank to which it is entitled by its importance. Meanwhile, we hope and believe that the President of the American Gas Light Association (Mr. Joseph B. Crockett), even though he is President of the San Francisco Gas and Electric Company, will, in the instance of the proposed renaming of the Pacific Coast Gas Association, remain true to the cause which put him at all prominent in the lighting industry of the United States.

PRESIDENT STEVENSON'S ADDRESS.—In this issue we give the full text of the address of the President (Mr. G. E. Stevenson) of the Incorporated Institution of Gas Engineers, of England; and it is with much satisfaction that we say the gentleman who presided over the Incorporated Institution's eighth annual meeting spoke his piece with credit to himself and with greater credit to the profession which he for many years has unobstrusively and completely served. It is seldom that the "I" is so little in evidence in an inaugural address (be it either English or American), and seldom is it oftener that the addresser puts in easily understood language matters of vital moment, that have to do with the construction and operation of gas works—from the generating to the distributing end thereof. If dear old Mr. Livesey could be prevailed upon to merge his individuality to the point of even simulating Mr. Stevenson's knowledge and discretion, how much better it would be for the entire great gas interests of London, to say nothing of the other important gas interests of England. Mr. Stevenson, however, whether or not Mr. Livesey is to be commiserated, looks to us to have paved the way to a re-united English Gas Institute, even though Mr. Stevenson never once alluded to such a re union, or its possibility, in his well written lines. By this time, Mr. Livesey should comprehend that choler is not argument.

NOTES.—Mr. W. H. Rogers, Agent of the United Gas Improvement Company's Paterson (N. J.) branch, is quite satisfied over the results that have followed the reduction in rates made last March. The net rate there now is $1.25 per 1,000. Many ranges have been placed.—— An ordinance granting to the Northern Gas and Electric Company the right to transact business in Norwalk, O., has been adopted.

Address of the President (Mr. G. E. Stevenson) to the Members of the Incorporated Institution of Gas Engineers on the Occasion of Its Eighth Annual Meeting.

Gentlemen—It is with a profound sense of the honor you conferred upon me, by electing me your President this year, that I rise to address you this morning. To-day the Institution meets again, in the eighth year of its existence. Our numbers have increased year by year, and we now have over 200 on our rolls. Although still not a very large body, we represent a very important section of the gas industry of the United Kingdom. The gas undertakings represented by our own members manufacture some 83,000,000,000 cubic feet of gas per annum; this being equal to 65½ per cent. of the total output in Great Britain and Ireland. We have also enrolled among our members the engineers of some very important Continental and Colonial gas works.

Though only eight years have elapsed since the Institution was incorporated and commenced its career, it has already accomplished much useful work. By papers and discussions at our meetings, the value of modern improvements in carbonizing plant, and in machinery connected therewith, has been emphasized. Special attention has been given to new methods of gas making, and to the recovery of additional by-products resulting therefrom. A special sub committee of the Institution have carefully tested a proposed photometric standard, and determined its relative value. They have also studied the question of temperature as affecting the percentage of unaccounted for gas, and approximately defined the lines upon which corrections for temperature should be made in the registration of the station meter in order to correspond with the temperature at which the gas is sold. The Institution has discussed the relationship of gas workers to their employers, and shown how, in one instance at any rate, a happy solution has been found for the difficulties that existed. The Institution has not confined its attention solely to the phases of gas works management in Great Britain, but has sought acquaintance with the aspect of things on the Continent; visiting last autumn cities in Holland and Belgium, where the members received the greatest courtesy and kindness from their fellow gas engineers in those countries. The return visit of the Dutch Association of Gas Engineers to London this week will afford the Institution an opportunity of reciprocating the courtesies shown to the members last year, and of cementing a friendship so happily begun on the other side of the Channel.

In some respects our meeting this year cannot be said to be inaugurated under quite such rosy auspices as in 1897. We have to deplore the loss of two members through death since we met last year—one a very prominent member, and a Past-President of the Institution, whose place amongst us cannot easily be filled up. We are powerless to prevent these sad occurrences; but when they occur, let us brace ourselves to maintain the reputation of the Institution for energetic and useful work as the best anti'dote to the inroads of the Great Reaper. More especially let us look to the younger members of the Institution to keep alive the originality of our proceedings, and give them every possible encouragement to impart their views and describe their experiments. To the younger men will fall the work of improvement and progress in the future; and while a ripe experience is not to be under-valued as a guiding and correcting influence, the new hands are those most fitted and most free to develop the new ideas, and to bring them to a practical issue.

Last year we met fresh from the realization of a great increase in the annual consumption of gas, which induced sanguine expectations of rapid augmentation in the extent and importance of our gas undertakings. This year we come together in the knowledge that, temporarily, these expectations are not to be realized. The fickle climate under which we in Britain are placed has ordained that an unusually mild winter should put a restraining hand on the demand for gas; and in some of the larger undertakings the consumption has remained more or less stationary in the past year.

The serious and prolonged strike in the engineering trades, which lasted from July, 1897, to February, 1898, was not without an important influence on the progress of the gas industry. It deprived us of many sources of gas consumption, and otherwise affected us prejudicially in delaying the execution of contracts for ironwork and machinery required for last winter's work. The strike directed the attention of the public afresh to the seriousness of the labor question; and it was felt more than ever that steps must be eventually taken to bring about a community of interests between employer and employed. In all branches of employment there is still far too much of the old idea that the person employed is in some sort of sense a chattel of the employer; and, though the British workman has to a large extent succeeded in

emancipating himself from his bondage, he is yet almost universally in the position of being eventually used up by the system under which he works, without having the chance of sharing in the prosperity which his labor has created, or reaping any after benefit from his years of service, when his power as a worker fails. So long as the worker has no direct interest in the prosperity of the undertaking he works for—be it private enterprise or public concern—it is not surprising if he seeks his own immediate benefit, even though it be at the cost of ruining the industry with which he is identified. Once let him, however, be placed in the position in which he can see that his own interests and those of the business are identical, and he will think for the future as well as for the present, and a common ground will be established. That such a condition of things may be brought about by a judicious application of the profit sharing principle has already been proved in more than one class of industrial enterprise.

A strike of workmen invariably gives increased force to the arguments in favor of the adoption of machinery for all mechanical purposes. It is not that there is any aim to ultimately reduce the number of workers, but that a way may be found to, in some degree, accord to them the remuneration and comfort they desire, without at the same time handicapping the industry with an increased cost of production. Thus, in gas works the adoption of machinery for handling the raw material and solid by-products is becoming more and more universal. In small undertakings the committees and boards of directors are now found willing to spend large sums of money on means to effect this—in some cases, it may be, without due regard to the return that may be expected, but always with a view to diminish the multiplicity of hand laborers engaged in unintelligent operations, and to increase the status and responsibility of the workmen.

As a necessary consequence of the fulfillment of these aims, the capital cost of installations of new carbonizing plant has increased while the working expenses have diminished. There is nothing surprising about this, for, in the first place, whatever current expenditure is saved by transmitting the energy employed in mechanical operations from manual power into power exerted by machines must in the process of conversion be capitalized; and, secondly, as the interest payable on capital becomes less and less, so it becomes more and more advantageous to capitalize the expenses. At the present day the cost of equipping a large retort house with modern regenerator settings, power machinery for stoking, and machinery for elevating and conveying the coal and for removing the coke, amounts to about £100 per mouthpiece. This cost may be roughly divided as follows:

Retort house with stage floor	£35
Retort settings and fittings, including chimneys	40
Stoking machines and coal elevators, etc.	15
Coke conveying machinery	10
Total	£100

Inasmuch, however, as a greater duty is obtained in gas production per mouthpiece per diem from modern plant, the cost of construction has not been proportionately increased in relation to the producing capacity; and it may now be taken to be equal to about £12,000 per million cubic feet per diem. But modern retort houses perform their work at much lower cost for labor than the old description of plant. What formerly cost 3s. per ton of coal carbonized is now done by machinery for 1s. 9d. per ton. This means a saving of £1,250 per annum for every million feet of daily productive cpacity.

The lowest estimate I have seen for the cost of a ground floor retort house worked entirely by hand is £8,000 per million per diem (H. E. Jones, "Proceedings of Civil Engineers," 1875). Taking this as the standard of cost of the earlier type of retort house, the saving effected by the application of modern machinery yields a return of 30 per cent. per annum on the increased capital expenditure. Besides this saving in the cost of manufacture, we have gained the advantage that from 30 to 50 per cent. more gas than formerly can now be produced on the same ground area.

The modification of the carbonizing plant known as the inclined retort system has, during the past six years, gradually acquired importance, both in England and abroad. Accompanied in the first attempts by difficulties and disappointments, it has fought its way to a firmer position, and now bids fair to become more and more universally adopted. No doubt exaggerated claims have been made on its behalf; but it cannot, I think, any longer be denied that it possesses certain very definite advantages—more especially for works the magnitude of which is not sufficient for the full development of power stoking machinery. Even in competition with stoking machinery, it is my belief that the inclined system is destined to display a distinct advantage. It is, perhaps, not at first quite easy to see wherein this advantage lies. There is the same retort area, with the same results in distillation: the same expenditure of energy is necessary to bring the coal to the retorts, and to remove the coke. Wherein, then, is a saving in labor to be effected? I have come to the conclusion that the source of further economy is to be found partly in the fact that the coal, once it is elevated and conveyed into position for charging into the retorts, does not again require to be moved otherwise than by gravitation, and that no power, other than the same force, is needed to bring the coke out of the retorts; and partly because (at least, if retorts 20 feet long are employed) an equal quantity of coal is charged in half the number of operations. It is evident that the cost of attendance ought to be less when the coal finds its way into, and the coke out of, the retorts by virtue of their own weight, instead of having to be lifted and conveyed by power into and out of the receptacles for distillation. The cost of wear and tear should also, under these circumstances, be reduced. That up to the present time no absolutely reliable proof has been forthcoming that inclined retorts possess this economical advantage over machine stoking I regard as due to the fact that as yet no installations of inclined retorts have been worked on a sufficiently large scale, and under such propitious circumstances as have for some time past attended mechanical stoking.

The cost of constructing inclined retort settings is certainly greater than that of horizontal settings. In fact, from my own experience, I should put it at 50 per cent. more for the settings themselves. But possibly some reduction may be expected in the cost of the accompanying machinery. Should it be found, however, as I fully anticipate, that a reduction of 6d. per ton in wages over and above the saving which can be effected by machine stoking is to be realized, this additional saving will amount to 20 per cent. on the increased capital expenditure. One thing is certain about inclined retort settings; they must be very carefully constructed, and very substantially braced by strong ironwork. Any neglect of these precautions is simply courting failure.

No radical departure from the usual type of carbonizing plant has yet been introduced with success. Devices for the continuous carbonization of coal in small quantities, constantly fed into retorts, have hitherto met with insurmountable difficulties, both in respect of the maintenance in good working order of the apparatus, and in the quality, and the means of removal, of the coke. Carbonization in bulk has received some encouragement in the progressive types of coke oven now in vogue—notably that known as the Semet-Solvay system, with internal heating flues. But in this type of oven the bulk of the material dealt with is to a great extent sacrificed to other considerations; and the actual result is a nearer approach to the masses of material we are ourselves accustomed to carbonize.

The cost of repairs on a modern gasworks of magnitude is enhanced by the multiplication of machinery effecting the various of operations, but not to an extent that seriously affects the total working expenses. The following analysis of the expenditure under the head of wear and tear at a large works where the stoking is all performed by machinery may be of interest, as showing the proportion due to each of the different operations carried on. I will not tax your patience by reading over the items; but you will notice that stoking machinery costs slightly more than 2½d. per ton for maintenance.

Analysis of Cost of Wear and Tear per Ton of Coal Carbonized at the Rochdale Road Gas Works, Manchester.

Coal delivery department, including railway lines, locomotive capstans, stages, steam cranes, etc.	0.84d.
Retorts—repairs and renewals of retorts and furnaces	6.66
Retort fitting, including furnace fittings	2.40
Stoking machinery, including elevators and conveyers, and engines working same	2.58
Tools—retort house shovels, barrows, etc.	0.75
Sundries, in retort houses only	0.51
Boilers, including boiler fittings	1.09
Exhausters, including engines and pumps	1.66
Condensers, washers and scrubbers	0.33
Purifiers, including lifting gear for covers and elevating machinery for oxide, etc.	1.05
Station meters, gasholders and governors	1.15
Workshops, including tools and machines in same	0.62
General (not applicable to above headings)	1.34
	1s. 8.98d.

Before leaving the subject of modern carbonizing plant for coal gas manufacture, allow me to contribute one additional proof to the many which have been adduced, of the value of the regenerative system of

heating retorts. Up to the year 1891, the retorts at the Rochdale Road station of the Manchester gas works—numbering 1,066 mouthpieces—were all heated by the old method of direct firing. The quantity of coke sold in the year ending March, 1891, amounted to 6.67 cwts. per ton of coal carbonized. The reconstruction of the retort settings was commenced in that year by the erection of a bench having producers, but no regenerating flues. The result, so far as saving of fuel was concerned, was practically *nil*. Subsequently regenerators were added to the same settings, and further reconstructions were undertaken in which the principle of regeneration was fully applied. Last year three-fourths of the retorts in use at the works were heated on this system; and the coke sold had risen to 8.78 cwts. per ton of coal—the increased sales in that year representing an additional quantity of 15,330 tons of coke, the revenue from which was, in round figures, £4,000. At the present time all the retorts are on the modern system, and the works are now turning out 9½ cwts. of coke for sale per ton of coal and cannel carbonized. This, it should be noticed, is with a consumption of 40 per cent. of cannel, much of which produces little coke, and that of inferior quality.

The manufacture of carbureted water gas is a development which has already obtained considerable extension in the more important gas undertakings in Great Britain. As an instrument for the enrichment of coal gas it has proved itself more economical than cannel under existing prices of oil. An analysis of the working expenses at Manchester, extending over four months of last winter's work, gave a net cost into the holders for 25-candle carbureted water gas of 1s. 1.65d. per 1,000 cubic feet. It would certainly not have been possible to make 25-candle cannel gas at this price. When mixed with coal gas to the extent of 25 per cent. of the total, no inconvenience has been experienced from the greater density of the gas, nor has any complaint whatever arisen among consumers which could be traced to the admixture of water gas. It may be doubted whether the supply of carbureted water gas alone, or even as the greater proportion of the total, is desirable or prudent in this country. If for this purpose the water gas be made of lower illuminating power, the same advantage in cost price is not maintained. Water gas of 20-candle power costs only 2d. per 1,000 cubic feet less than does gas of 25-candle power; the difference being merely due to the lesser quantity of oil consumed. Though the opinion of experts has been freely given in favor of the harmlessness of supplying water gas, there are not wanting signs, even in America, of a tendency to restrict the supply of the unmixed gas. The inquiries made at Boston, in the United States, show that a feeling exists that the percentage of carbon monoxide in illuminating gas should be kept within certain limits.

The advantage of a water gas plant in providing a means for the rapid augmentation of the gas production when required has been frequently commented upon. It possesses also very important advantages in the lesser capital cost of the plant for a given make of gas, and in the comparatively small area of ground space on which plant of large productive capacity may be installed. As to the capital cost, it has been stated that carbureted water gas plant costs only half, or less than half, what coal gas plant costs. This I regard as incorrect. From the data afforded by our own experience in Manchester, I find the cost, for all appliances up to but exclusive of the purifiers, to amount to two-thirds that of coal gas plant. In round figures, the cost is £15,000 per million cubic feet per diem for coal gas, and £10,000 per million cubic feet for water gas.

It has been assumed that the manufacture of carbureted water gas entails less expenditure on purifying plant than is involved in coal gas making. This, I think, is wanting in confirmation. If the carbonic acid is abstracted, it is found necessary to have even more purifying area in proportion to the make of gas than is required for purifying coal gas from sulphureted hydrogen alone.

Future designs for the extension, on a large scale, of carbonizing plant will probably take the form of a combination of the inclined retort system for coal gas, with carbureted water gas as the principal instrument of enrichment. Such a combination possesses many advantages. The capital expenditure can be kept within reasonable limits by the lesser cost of the water gas plant; the productive capacity per unit of ground area will be at a maximum, and the working expenses at a minimum point. It must, however, not be forgotten that the cost of making carbureted water gas depends to a very large extent on the price of oil; the cost of the oil amounting, even at the present low prices, to over 70 per cent. of the total cost for gas of 25-candle power. A slight rise in the price of oil would therefore upset the balance of advantage; and, consequently, it would not be wise to be dependent upon water gas to too great an extent.

During the past year the attention of gas engineers in this country has been directed to two new possible methods of gas enrichment. One is that of returning a portion of the purified gas into the crude, and still heated, gas; the theory being, it is assumed, that the addition of gas from which all condensable products have been abstracted to the gas still charged with heavy hydrocarbon vapors will enable the latter to retain certain hydrocarbons in suspension which otherwise would become liquefied. This process appears to have been carried on by Mr. Shadbolt, of Grantham, with success, and his results have recently received confirmation from an American source. The other method has arisen out of proposals emanating from Mr. Young, of Peebles, and Mr. Glover, of West Bromwich. These proposals, having for their primary object the elimination of naphthaline deposits, consist in the distillation of part of the coal or cannel at a low temperature, in order to produce a gas highly charged with illuminating vapors—which vapors the gas would not, if cool and unmixed with other gas, be able to retain—and then mixing this gas with poorer gas produced at a high temperature. Experiments made by Mr. Samuel Glover, at St. Helens, go to prove that this method has for its result a decided increase in the illuminating power of the combined gases, as well as an important effect on the deposition of naphthaline.

Both these departures from the ordinary methods of procedure open up a new phase of the question of the distillation of coal and cannel, and point to the desirability of a better understanding of the particular treatment required by different classes of material. Nothing can be more certain than the fact that, in carbonizing a heterogeneous mixture of different kinds of coal and cannel under the same set of conditions there results a loss of illuminating value all round. In large works carried on under such circumstances the proportion of cannel required to maintain a certain illuminating power is much in excess of that which the value of the different materials, as revealed in experimental tests, shows to be really necessary.

In regard to the appliances for condensing, exhausting, washing and purifying gas, no important advances can be said to have been recently made. Endeavors to utilize the ammonia in the gas as an agent for the partial removal of the carbonic acid and sulphureted hydrogen have met with a large measure of success in the hands of Mr. Holgate; but the complete purification of gas by liquid reagents seems as far off as ever. Experiments made at one of the Manchester gasworks with a view of reducing the sulphur compounds by washing the gas with ammonium sulphide point to the necessity of saturating the causticised ammoniacal liquor with sulphur from some external sources, in order to produce a reagent sufficiently powerful, and in large enough quantity, to effect any important result.

Exhausting plant remains the same in character as heretofore. Having regard to the importance of securing a permanent relationship between the volume and speed of the gas passing through the purifiers and the area of the latter, it has often surprised me that in large works the exhausters are not so arranged that each separate stream of gas is driven by an independent exhauster, or set of exhausters, through independent washers, into separate sets of purifiers, instead of the division of the gas into two or more streams being made after the exhausting and washing apparatus has been passed. Such a disposition of the plant would, it appears to me, ensure more complete control over the action and effect of the purifiers. It is possible that some of our London members have carried out this idea unknown to me; but I have not seen a works where, to my knowledge, it is in practice.

Much the same must be said of the purifying plant as of the foregoing; it remains essentially what it has been for the last twenty years. Certain ingenious attempts have recently been made in America to obviate the necessity of opening purifiers when a change of material is required, and to effect this change by the successive removal and replacement of the material by mechanical means while still inclosed in the purifying vessel. Nor are there wanting proposals in this country for the construction of purifying machines in which the gas may be treated with the usual purifying agents on a continuous and automatic principle. To what extent the appliances devised for these purposes will eventually commend themselves remains to be determined. However crude at the present moment, they may prove to be the germs of some very practical system to be developed in the future.

While the cost of carbonizing plant has tended to increase that for the storage of gas has diminished. Large gasholders are now the rule; and active spirits are still busy perfecting methods for safely dispensing with the guide framing, so long deemed to be necessary for the stability of this bulky apparatus. It must ever remain a matter of opinion whether the saving to be thereby effected in first cost is worth running any risk for; and it has yet to be proved—at any rate, in the case of very large gasholders—that absolutely no risk is incurred by dispensing

altogether with the guide framing. The concentration of storage capacity in one, or at most two, large holders entails no anxiety in our days; and much advantage is found to be derived therefrom in the simplification of the connections, and generally in the working details, as well as in the reduced capital expenditure per million cubic feet capacity.

Of the distributory plant of gas undertakings we hear very much less than its importance demands. The mains and services, being placed out of sight, do not attract the same attention on the part of directors and committeemen as do the parts of a gas works. Nevertheless, the capital invested therein is very considerable; and the well-being of an undertaking is much influenced by the adequacy, or otherwise, of the provision made for delivering the gas to the consumers. In large cities the difficulty of laying trunk mains in the principal thoroughfares becomes more and more serious as these streets become the receptacles for electric cables, hydraulic pressure pipes and other mediums of the supply of public conveniences. I am afraid that, for the most part, the system of gas mains in our large provincial towns remains very much what it was in the early days of gas lighting, notwithstanding the immense extension which has taken place in the area of supply and in the volume of gas to be delivered. The number of leading mains proceeding out of the works has been multiplied; but the same principle of distribution has been maintained—viz., that of initial pressures of comparatively low degree, commencing at the works, and diminishing as the mains pass through the district and the gas is drawn off for consumption.

That this is, under existing conditions, an inadequate and wasteful system goes without saying—inadequate, because it cannot accomplish the desired effect of maintaining a uniform pressure throughout the district; and wasteful, because it means the sinking of an unnecessary amount of capital in a multiplicity of large leading mains. Electricians soon discovered that low pressure supply entails too heavy a capital expenditure; and, although gas mains are less costly than electric mains, there is no reason why we should adhere to a system the defects of which are so apparent, when the same remedy is just as easy to our hands as to those engaged in electric lighting. The fear of high pressure in conducting mains is a bogey the dangers of which are greatly exaggerated. We know from experience that mains of considerable size, if well laid in the first instance, do not give rise to leakage of any importance. Why, then, should we not have high pressure trunk mains delivering gas into the distributing mains through governors, acting as transformers, situated in convenient positions in the district, in or near the centers of consumption? By adopting such a system we could dispense with the constant duplication or enlargement of leading mains; and the problem of increasing the delivery of gas would resolve itself into putting additional governors in fresh positions, and connecting them to the district mains.

Too little is known about the proper relationship of the mains to the consumption. Although there are well defined formulæ for the calculation of the capacity of main pipes as regards the delivery of gas, yet the size and number of main pipes used for the supply of a definite hourly quantity is subject to an almost infinite variety; and the divergencies between the main piping in one town and another are most unaccountable. There are, of course, differences in the conditions of supply in different towns; but it is difficult to believe that these differences are so great as to account for such divergencies in the length of piping, and the consumption of gas, as are to be found among the returns of gas undertakings.

Then there is the question of unaccounted-for gas. Out of a total annual make of gas in the United Kingdom amounting to 127,000,000,000 cubic feet, 10,000,000,000 are unaccounted for, representing 1,000,000 tons of coal annually apparently wasted so far as any return for it is concerned. This is equal to 8 per cent. of the gas made. Although part of this is, no doubt, due to shrinkage through reduction of temperature, there still remains a serious deficiency which cannot thus be accounted for. There does not appear to be much difference between gas companies and municipal undertakings in respect of unaccounted-for gas. There are, however, many undertakings of both kinds which fail to come up to the usually accepted standards in regard to sales of gas per ton of coal. Among the companies, 52 per cent. of the total number included in the last Parliamentary returns sell under 9,000 cubic feet to the ton, and 19 per cent. sell under 8,000 cubic feet per ton. Of local authorities, 54 per cent. sell less than 9,000 and 16 per cent. less than 8,000 cubic feet per ton. Amongst the small undertakings, both of companies and local authorities, are to be found the most extraordinary sinners in this respect; but there are not wanting undertakings of magnitude whose returns might be improved with marked advantage to themselves. There is surely proof here that the distributory plant does not receive the attention which it deserves. Whether the discrepancy between the gas made and the gas sold is to be charged to leaky mains, decayed service pipes, or incorrect meters, there are defects somewhere which might and ought to be remedied.

Whilst upon the subject of the returns as to gas undertakings, I wish to call your attention to the fact that the number of authorized undertakings owned by companies has in ten years increased by 14 per cent., and those in the hands of the local authorities have increased 28 per cent. But the capital employed by the companies has increased 35 per cent., whilst that of gas works owned by local authorities has increased only 27 per cent. In 1886 the capital employed by gas companies amounted to £6 6s. 9d. per ton of coal carbonized; in 1896 it amounted to £6 9s. 2d. per ton—an increase of 2s. 5d. The capital employed by local authorities amounted in 1886 to £5 12s. 1d. per ton of coal; in 1896 it stood at £4 8s. 10d. per ton—a reduction of £1 3s. 3d. per ton having taken place.

These figures reveal the great advantage local authorities possess in the redemption of their capital by means of a sinking fund—an advantage which it has been suggested should be given to gas companies also. Surely, however, apart from this, it might be expected that the companies would, in the course of a decade, show some reduction in capital account per ton of coal carbonized due to their growth of business; for, as the magnitude of the operations increases, the cost of the additional plant diminishes, and the dead weight of capital due to preliminary expenses becomes spread over a larger total. I make these remarks in the full knowledge that many companies do keep this desired end in view, and follow it successfully.

There is another influence at work, the effect of which is all in favor of an ultimate reduction in the proportionate capital employed, and that is the gradual leveling-up of the day consumption, and the diminution of the difference between the summer and winter consumption caused by the employment of gas for other than lighting purposes. The rapidly extending use of cooking stoves, encouraged by the hire system and by the slot meter, with its accompanying free boiling stove, is continually increasing the proportionate consumption of gas during daylight hours. The use of gas as a motive power further assists in accomplishing this result. During ten years the day consumption in Manchester has risen from 20 per cent. to nearly 30 per cent. of the total; and I do not doubt that there are many undertakings in which a more marked result has followed the endeavors made to develop the day consumption. As for the winter consumption as compared with that of the summer months, we find in Manchester that the rate of increase is greater during the latter than during the former, and that the extension of electric lighting has tended to keep down an unusually large demand on foggy days in winter, while not perceptibly affecting the annual consumption as a whole.

In the matter of utilizing the energy in coal gas we are yet only in the elementary stage, but great changes are impending. Hitherto a mere fraction of this energy has been converted into light; but the atmospheric burner and the Welsbach mantle have opened the way for the conversion of a much larger proportion of the store of heat energy contained in gas into illuminating effect. The improved burner now being introduced by the Welsbach Company will, it is believed, greatly enhance the value of this method of lighting. The importance of these developments can hardly be over estimated. While the utilization of the energy of the electric current as applied for producing light has apparently little margin left for improvement, there remains an almost boundless surplus energy in gas. Its economical conversion into light must be our special study in the immediate future. When gas lighting becomes independent of the direct illuminating power of the gas, we shall be able to supply a gas which, while satisfying all requirements for illumination, will be cheap enough, and yet possess sufficient energy for all the various purposes, industrial and domestic, for which gas is so eminently convenient. Under such improved conditions, public lighting by gas will continue to be the cheapest and most effective system; and as the consumption of gas per unit of light evolved diminishes and the consumption for other purposes increases, the present strain on the resources of the gas works in our large towns, due to fogs added to the normal winter consumption, will be relieved, and a more regular rate of consumption will be attained.

One source of the revenue of gas undertakings has unfortunately been of late a diminishing quantity. I refer to the sale of our residual products. Tar and ammonia do not at present, and probably never will again, command the prices they once did. So far as tar is concerned gas tar does not now contain so large a proportion of the more volatile hydrocarbons as formerly; but seeing that the market value of benzol

has become so reduced it does not appear that the lesser quantity of this constituent can seriously affect the returns realized for tar. In the manufacture of sulphate of ammonia the margin of profit has been so low during the last few years that only with plant of the most economical character, in which mechanical appliances have been substituted for hand labor throughout, could gas undertakings show any advantage in working up their ammoniacal liquor. There are now signs of a permanent improvement in the price obtainable for this product; and in the case of those undertakings which still sell their tar and liquor, the adoption of a sliding scale of prices has at last insured them a fair share of the profits to be realized. The endeavors which have been made to add to the returns from the by-products of gas manufacture by the abstraction of the cyanogen in the gas have not met with all the success anticipated, owing to the fluctuation and uncertainty in the value of cyanides. Coke still remains a valuable source of revenue; and the increased yield of coke for sale has done much to counteract the loss of income from the other residuals. Much may be done to create and maintain a good demand for coke, at fair prices, by studying the requirements of the district in which it is desired to sell it, and by providing the necessary machinery for cleansing, breaking and separating the coke and breeze into such sizes as are suitable for the purposes for which the former is required.

Gentlemen, I think you will agree with me that the foregoing review of the present position of the gas manufacturing industry, imperfect though it is in many respects, suffices to show that, while changes do, and inevitably must, occur in the conditions under which we have to carry on the business, there is nothing in these changes to alarm us, nor are they likely to be so sudden as to upset our calculations or revolutionize our methods. Nevertheless it behooves us to be on the alert to appropriate all such modifications as the change of circumstances may give rise to; and if we cannot ourselves become the initiators of them, to grasp and appreciate their value, and be the first to utilize them to our own advantage. I rejoice to feel that to this Institution, and to kindred associations in this and other countries, assisted by the technical press, belongs the credit of keeping alive the interest in, and bringing about the adoption of, all such improvements in the working administration of the numerous undertakings identified with the supply of gas—an industry in which, in Great Britain alone, more than 70 millions sterling are invested; and that the employment of this immense capital continues, under the technical management which we here to-day largely represent, to be uniformly productive of good financial results.

Important Considerations in Lamp Tests When Determining the Best Available Lamp for Central Station Use.

[A paper read by Mr. S. E. Doane, before the Northwestern Electrical Association.]

I want to begin by saying that an incandescent lamp is of no particular candle power. It is given a rating, but such rating is only partially descriptive.

It is capable of delivering many different candle powers, at as many different voltages. It can, however, deliver only candle power at one wattage. It is obvious then, that irrespective of resistance, if the surface of the filament does not change, the candle power of the lamp will remain the same, providing the wattage delivered to it is constant.

Neglecting for the moment all the exceptions having to do with the color of filament surface, the character of same, and considering for the time being all filament surfaces as alike, the area of the surface has all to do with the candles and watts per candle at varying voltages. This being the case, it is clear that a lamp giving a certain candle power at 100 volts will deliver more candles if operated at 104 volts, due simply to the fact that more energy is put into the filament, and in radiating this the filament has risen to a higher temperature and therefore delivers more light.

Change of resistance has very little to do with the change in the candle power of a lamp, for a well-built incandescent lamp does not change its resistance materially throughout its effective life, although its candle power changes considerably. This being the case it is obvious that any change in candles without a change in watt consumption must be due to change in the surface of the filament.

How should incandescent lamps be rated? This is not an idle question. It has been the misfortune of some lamp manufacturers to lose competitive tests, when really they have won, because of an improper analysis of the results by the purchaser, though the purchaser has acted in perfect faith, honesty and to the best of his judgment. To explain: A station manager purchases several lots of lamps and sets them up for a test. For convenience sake let us assume he has secured lamps from three makers and when placed on test that they give the characteristic curves of candle power shown in Fig. 1.

Lamp No. 3 he is warranted in saying is poor. Lamp No. 1 he may hastily decide is the best and may place his business with this manufacturer. Let us say such is the case.

Curve No. 1 is not of unusual shape and type. As placed before you the candle power is shown to have risen and in five hours to have reached approximately 18 candles.

It very frequently happens that the maximum candles is reached, as it may have here, in less than five hours. Observations should always be taken early enough so that at least two readings, if the lamp rises much in candles, come on the upward portion of the curve. The importance of the statement will be apparent when you note that in this case, if we assume that the readings were not taken until 100 hours, the lamp would have been shown to have risen only 5 per cent., about 0.8 of a candle. If the readings had been taken at the end of about 170 hours it could have been assumed that the candle power had not changed from the beginning, and the fact that having been a rocket it is now a stick would be lost sight of.

It is not unusual to see the reports of lamp tests in which the candle power of the lamp is said to have "remained unchanged for many hours." There is a very small chance that this is true of any lamp test. An inspection of the curve for the remainder of the life of the lamp usually shows that the lamp had probably risen very high in candles, and that the first reading after the initial had been taken at the time when the decreasing candles were the same as they were initially, having in the meantime been much greater.

Before passing to the discussion of these lamp curves we should establish our premises that we may interpret them in common. I believe there is no ground for debate on the two following statements:

First—The candle power of an incandescent lamp never remains absolutely constant, and, barring the first sharp rise, it constantly falls.

Second—The curve of change in candles in an incandescent lamp is nearly a straight line, and for all practical purposes can be considered

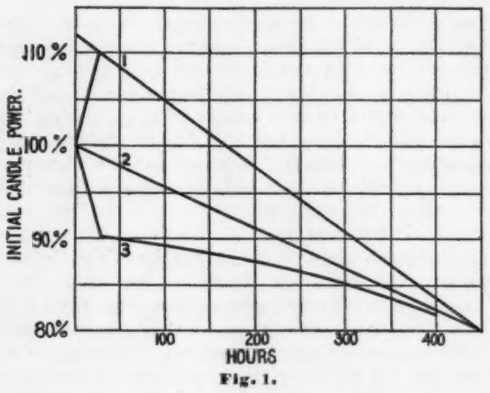


Fig. 1.

as such. This, of course, neglects the first rapid rise in candles and the sudden slump at the finish, when the defect, which finally causes the failure of the lamp, has reached the acceleration period of its development.

The lamp shown on curve No. 1 is inferior from a practical, commonsense standpoint. No station manager wishes, in passing through the streets of his town, to see bright and dim lamps burning side by side on his circuits. The lamps which vary least in apparent candle power are the most satisfactory to his patrons.

In spite of curves, figures, statements and discussions the belief is still general that the sole gauge of this difference of illuminosity is the difference between the initial candles, and the candle power at the end of a predetermined number of hours.

This is rarely the case. Almost all incandescent lamps immediately rise in candles. This preliminary rise is very rapid. The maximum candles are frequently reached after the first one or two hours. Such being the case, what is the true initial candle power of a lamp under test, and how much has the candle power rating to do with the ultimate decision of the would-be purchaser?

Why should a lamp be bought and termed "16-candle power" when within an exceedingly short space of time it gives 18 or 19-candle power?

Should a purchaser of a 3-watt lamp be pleased if by its rise in candle power it produces light at the rate of 2½ watts per candle, but subsequently suffers a rapid decrease in brilliancy because of this high filament temperature? Would it not have been better if illumination at the brilliancy produced by filaments at a 2½-watt temperature was desired, to have consulted some lamp engineer, with a view of producing this extraordinary condition in the best engineering manner? Would any of you dream of overloading your generators, deliberately closing your eyes to their obvious overheated condition, and invite final disaster, because your generators were rated to operate at a given number of amperes, and your ammeters lied?

Is it wise to buy lamps labeled 16 candle power if after the first five hours they rise to 18 and subsequently fall to 14-candle power or less, giving you very bright and comparatively very dim lamps on your circuits side by side? But such lamps have caused lamps really well made to be considered inferior because the area of candle power hours of the latter was less, although the real maintenance of candle power was superior.

Why should a manager desire a lamp which rises in candles? If he buys a 16-candle power lamp, is he purchasing a lamp which he wishes to deliver 18 or 20 candles or more after a few hours? Is he not deceiving himself? Would it not be better for him to understand that he is purchasing an 18 candle power lamp? Would it not be better for him to buy one actually 18 or 20-candle power, which would not rise in candles? He could thus secure the benefit of the difference between 16 and 20, when the poor lamp was rising, and before it reached the peak of its curve, and at the same time view the conditions of illumination with his eyes wide open?

There are differences of opinion as to whether or not it is good or bad policy to deceive your customers. In the writer's estimation it is decidedly bad. This without regard to the moral status of the question. There should be no discussion as to whether or not a man should deceive himself.

Fortunately, it is not essential in discussing a lamp test to find just the height to which a lamp rises, as the most satisfactory lamps do not rise in candles, or at least rise very little, and readings on these lamps will show that the candle power curve almost from the beginning is very close to a straight line.

To refer back to the original question, what is the proper rating? Should not the rated candle power be the maximum candles during any part of the life? Should not the difference between the maximum and minimum candles be the gauge of the lamp's performance? It would seem to me that by far the best method of analyzing roughly a lamp test is to add the per cent. increase to the per cent. decrease in candles and call it all decrease. A few of us are guarding against this rise in candle power and trying as hard to overcome it as we are the fall.

If the smashing point of an incandescent lamp is at that time when the candles have reached a given percentage of their maximum value, that lamp is best which, starting at the same initial candles as its competitor, makes the nearest to a straight line to the percentage of maximum candles which has been set as a proper smashing point. This, of course, affords a comparison only between lamps starting at the same initial watts per candle.

The belief seems to be growing that the value of a lamp to a station can be obtained by putting a planimeter on a lamp curve, and averaging thereby the candle power hours to the time when, by reaching a given percentage (80, for instance) of its initial candles, it has reached its smashing or breaking point. This seems to me to be wrong, as it places a premium upon the rise in candles before mentioned.

It may not be generally appreciated that the cost per average candle power hour constantly decreases as the candle power for a given total wattage is increased. To illustrate: A 24-candle power lamp taking 60 watts—that is, 2½ watts per candle, providing it does not break, gives a greater illumination for a given consumption of watt hours, through a period well past the economical smashing time, than a 20-candle power 3-watt lamp.

The candle power of the 24 candle power lamp is higher at the end of any number of hours. It is very evident from this that if the 20 and 24-candle power lamps had been started on the same basis—that is, the manufacturer had succeeded in having his 24-candle power lamp called a 20 at start and allowed the photometer to tell the remainder of the story—he would have had a lamp curve similar to No. 1.

Fortunately, or unfortunately, an incandescent lamp lends itself quite easily to deception. A little rough handling of the lamp on the pumps will blacken the filament and reduce its candle power. But this blackening is radiated after a few hours, so that the filament again returns to its steel gray color, and the candle power to that normal for a treated surface.

A lamp of given candle power at a calculated voltage, which has had its filament lightly blackened on the pumps will give its candle power at a voltage higher than that calculated, because the blackened surface of this filament radiates the heat much more rapidly than the normal gray treated surface, and consequently does not get hot enough at its intended voltage when measured initially, but after several hours this black, sooty coating has been radiated to the bulb, and the filament returns to its normal color. We have then a lamp of lower voltage, and normal characteristics operating upon circuits where the voltage may be one, two or more volts greater than that necessary to produce the determined candles at the proper watt per candle.

If you want a larger area in your lamp curve, as determined by your planimeter, assume your initial candles to be less than you know that they actually are and neglect to measure them initially for record. See that your lamps do not consume more than a given number of total watts. You will then have a lamp test which will give you a curve similar to No. 1 in shape, with an average candles 100 per cent. of the initial, if you wish. Of course I do not make this suggestion seriously. The area bounded by the candle power curves and their axes of origin is a measure of a lamp's candle power hour value, but it is not a measure in terms of the initial candles. I believe that a station manager has something to consider besides averaging candles and economy, and that he must place a limit upon the maximum difference in candles allowable, between a new and old lamp. His customers will all be clamoring for the "new" lamps, providing there is too great a difference in candle power between the new and the old.

The appearance of a lamp, whether it be bright or dim, is governed by the temperature of the filament, which is measured (speaking roughly) by the watt per candle.

It is very difficult for even a lamp expert to see the difference between a 20 candle power and a 16 candle power lamp, if both lamps are operating at the same watts per candle. The greater the surface of the filament, that is, the higher the candles, the brighter the lamp looks at the same at 1.3 watts per candle, but this difference is not so great that an essential difference will be noticed between a 20 and 16. A 16-candle power lamp, delivering its 16-candle power at 3.1 watts per candle, beside a 20-candle power lamp, delivering its candles at same efficiency, would not attract notice. If this 20-candle power lamp had dropped to 16 candles, without changing in total wattage, thereby delivering its 16 candles as it actually would in practice, at about 3.6 watts per candle, the difference in candle power would be immediately apparent to the consumer. The difference in the quality of the light delivered by the two lamps is what would have called this to his attention.

The color of the light delivered by the two lamps differs wideiy. The illumination as determined by the photometer may be 16-candle power. The effective illumination from the standpoint of the individual is a vastly different thing, and is not capable of being measured.

The light from a number of lamps of widely varying candles, or of the same candles, of even slightly varying efficiencies grouped together, is painful to the eyes, and, in a manner not wholly appreciated, grates upon the feelings of those who have occasion to make use of the illumination. Of course, when the source of light is not apparent, the objects illuminated, if of different colors, reflect only a portion of the rays from the light spectrum, because of their color selective quality, and therefore lamps of varying brilliancy may be used without the painful inconvenience which would result from the naked lamps being exposed to view.

It is more generally appreciated to-day than ever that there must not be a variation in the apparent efficiency of lamps side by side. That is, some must not be bright and others dim.

I say "apparent efficiency" advisedly. A 10 candle power lamp appears to be of slightly less efficiency than a 20, even when it is of the same efficiency. To procure perfectly satisfactory illumination, for instance, with the source of light in range of the vision, 100-candle power lamps at 3.6 watts per candle give better satisfaction that smaller units, even when the latter are burning at higher economy—say 3.1 watts.

This is the argument why lamps widely different in candle power should not be run closely together, as the illumination from these lamps will affect the eye differently, because of their different efficiencies. Generally speaking, then, this argument, followed to its conclusion, would be that lamps close together should be of the same candle power and efficiency, and if, in order to procure perfectly satisfactory illumination, it is necessary to use lamps of widely different candle power, take them out of the range of vision.

A lamp delivering 20 candles at 3 watts per candle delivers only 16-

candle power when operated at 4 per cent. lower voltage, and delivers this candle power at 3.6 watts per candle. A 16-candle power 3½-watt lamp, placed beside a 20-candle 3.1-watt lamp, looks exactly as if it was a 20-candle power lamp which had been burned so long that the candle power had fallen, and had arrived at this 3.5-watt temperature, because of long life.

Blackening of the lamp bulb is responsible for very little of the drop in candle power. The increase in area of the filament surface is responsible for most of it.

The blackening is indicative of the service a lamp has given, if its characteristics are known. Blackening is largely, if not wholly, a chemical effect, but the lamp which rises higher must always blacken more when compared with a lamp which does not rise in candles. We do not want black lamp bulbs any more than we do bright and dim lamps.

Almost every lamp rises in candles. Choose the lamp which rises least and discount even that rise.

To sum up:

Lamps do rise in candles. Everything is being done to obviate this rise and eventually it will be entirely avoided. We have not come to this yet, but we are nearer than ever before.

Decreasing the *rise* will do as much to maintain the uniformity of illumination as decreasing the *fall* of candles.

Bright lamps and dim lamps are equally objectionable, and it is my hope that I have made very plain what I started out to show, viz., that the most important consideration in determining from life tests the best available lamp for central station use is that the true rated candles of a lamp under test be properly determined. They, in my judgment, are the maximum reached.

High Pressure System of Distribution.

[A paper read by Mr. Fletcher W. Stevenson, of Sheffield, England, before the Eighth Annual Meeting of the Incorporated Institution of Gas Engineers.]

In large gas undertakings, having more than one manufacturing station, there will usually be provided pressure mains connecting the stations, to enable one to assist another in the case of an emergency such as may occur through local fogs, etc. This main may be utilized to supply *en route*, or, as an extension, an isolated gasholder station may be supplied from it; and the system of mains which are thus kept under gasholder pressure, the author terms a "High Pressure System of Distribution."

A system of distribution under pressure may be necessary even where only one works exists, owing to geographical conditions, or from the prohibitive cost of the large size of mains required to distribute from one place all the governed gas required during the few hours a day of heaviest demand.

Without describing the various ways in which high pressure systems may be carried out, which, like most other things, must depend largely upon local circumstances, the author ventures to describe that in use at Sheffield.

The Sheffield Gas Company have two manufacturing stations. The larger, Neepsend, has a maximum producing capacity of 8,500,000 and storage of 6,250,000. The smaller, Effingham street, 3,750,000 and 3,250,000 respectively. There is an isolated gasholder at Arundel street of 750,000 capacity, and two gasholders at Grimesthorpe of a joint capacity of 3,500,000. The total producing capacity is, therefore, 12,250,000 per diem, and the storage 13,750,000. The utmost producing capacity has already been reached, while the delivery in 24 hours has reached 14,000,000. A manufacturing station at Grimesthorpe is now in course of construction which will have an ultimate capacity of 10,000,000 per diem, and gasholder storage for this capacity will be provided, as required, at Neepsend. The difference in levels between any of the stations does not exceed 50 feet.

Originally an 18-inch diameter pressure main was laid to connect Neepsend, Effingham street, and the gasholder at Arundel street. This has now been replaced by a 30-inch diameter main from Neepsend to Effingham street, with extension as far as an 18-inch governor at Shude Hill, and a 30-inch main laid to the new gasholders at Grimesthorpe. A 24-inch diameter branch main has also been laid to supply a 30-inch governor at Granville Hill. The total lengths of pressure mains outside the works are 6,120 yards 30-inch, 156 yards 24-inch, and 1,220 yards 18-inch diameter, or a total of about 4¼ miles. The larger works at Neepsend supplies the pressure main chiefly, but Effingham street can do so when necessary.

Neepsend is provided with a 200,000 cubic feet per hour driving exhauster to force against the pressure thrown by the upper lifts of the gasholders at Grimesthorpe and Arundel street. The heaviest pressure thrown by these gasholders does not exceed 9 inches, and the maximum pressure at Neepsend, when driving against this pressure, is 12 inches. The minimum pressure in the main is about 3 inches, when supplied by the lightest lift of any of the gasholders.

As the new manufacturing works at Grimesthorpe come into operation, and it is necessary for them to supply the pressure main to get rid of surplus stock, a safety by-pass governor, similar to those in use between inlet and outlet of gasholders, will then be fixed at Neepsend to by-pass gas in case valves should be accidentally shut at the same time at Grimesthorpe and Neepsend, which, with imperfect telephone communication, is not an unlikely event.

One point should be impressed, namely, that the pressure main should be supplied from the outlets of the gasholders, not inlets; both for the sake of obtaining a uniform quality and in case of accident through outlet valve of the gasholder being closed, when gas would return from the inlet by the by-pass safety governor, and so maintain a pressure in the main.

The two chief objections which may be raised to a system of high pressure distribution such as has been described appear to the author to be: (1) The risk incurred by shutting a valve, so that the supply to the pressure main would be cut off and the districts supplied from it thrown into darkness; and (2) the leakage due to high pressure.

With regard to the first objection, no doubt the greatest care requires to be exercised, but the same may as truly be said of every operation upon a gasworks, and the risk is certainly mimimised by the use of the safety by-pass governors referred to. The second objection the author believes to be a hallucination. He is firmly of opinion that leakage does not occur, except under exceptional circumstances, from the large leading mains; and if these mains are gas tight at the normal pressure they will be equally so at the higher pressures. During the past 10 years the author does not remember more than four instances of leaks upon these mains.

The configuration of Sheffield, with its narrow valleys and high hills, its narrow streets and numberless bridges, renders the laying of large mains a difficult operation; and, accentuated as these difficulties are in our days by underground pipes for cables and telephones, electric light and electric haulage, the author ventures to think that without a system of high pressure distribution it would be impossible to lay sufficiently large mains to supply, properly, several of the company's districts.

The company's aim is to give a pressure of 20-tenths during heavy lighting time in all districts except such as are purely residential, and the maximum initial pressure required to give this does not in any case, except one, exceed 25-tenths.

Discussion.

The President declared that this paper had been prepared, at his request, at rather short notice, as he was very anxious that they should have at their meeting this year a discussion on distribution, a subject which had not largely come before them for some time. He hoped the paper would be the means of inducing a discussion on distribution generally and more especially on the question of modifications and improvements in the principle of distributing gas to meet the changed conditions of our large towns.

Mr. C. C. Carpenter, London, said this subject had largely engaged the attention of the chairman and engineers of the South Metropolitan Company, more particularly with reference to the large increase in the demand for gas which the past two or three years had seen. There appeared to be no doubt whatever, that the present system of distributing gas at a pressure which was sufficient for the consumers was an uneconomical one, and that a very large increase in the carrying capacity of the mains could be brought about by placing them under a high pressure and isolating the early portions of the mains from the consumers' meters. A plant for the purpose was in operation at one of the South Metropolitan stations throughout the whole of last winter. They used a Sturtevant blower in preference to the positive exhauster which he gathered Mr. Stevenson suggested at Sheffield. There were one or two advantages about the Sturtevant type of blower or exhauster. He thought the most important point was that the safety by-pass was not rendered necessary, because with the blower, it not being a positive machine, there was a full gas way whether the machine was revolving or whether it was not. An ordinary exhauster, as they knew, was a positive instrument, and unless it was kept in motion it acted as a very efficient stop to the progress of any gas, but with a blower of the kind that the South Metropolitan had been using it did not matter whether

the blower was running or not. If it was not running they got the full volume of gas through it. It had been their practice to use it during the hours of lighting. The first operation was to open the inlet and outlet of the blower, and the gas then went through in the usual way. As the time came for putting on the pressure the blower was started, and in two or three minutes the full speed was reached, supplying gas at whatever pressure might be desired. In their case they used it to draw gas at a pressure of something like 3 inches at the inlet, and that was increased at the outlet to as much as 7 inches or 8 inches. The quantity dealt with by one machine was approximately 300,000 cubic feet an hour. To do that a fan was used which was driven by a 6-horse engine and boiler, so that, if they compared that with an exhauster of a power to deal with anything like that quantity it would be seen that there would be an enormous advantage in using a blower of the type suggested in preference to the positive exhauster. He might further say that arrangements had been made to largely extend that system of distribution, and plans were now being considered for using blowers capable of dealing with 1,500,000 cubic feet per hour. He thought it would be impossible to deal economically with that quantity in any other way. With reference to the objection to the use of high pressure gas, the South Metropolitan had been using high pressure mains for the last ten years, having had two during part of that time, and part of the time three. The pressure in those mains ran up to 12 or 13 inches, and during the ten years he had never known of one leakage.

Mr. Livesey—They are not distributing mains.

Mr. Carpenter said they were not. Speaking from the point of view of safety, each of the mains was about a mile long, and they had been in operation for the last ten years. Only once had there been any serious leakage, and that was due to a large sewer bursting in a very busy part of the roadway through which the mains ran, so that he thought there was practically no danger of the leakage of gas. He did not think there was any great danger in distributing with 10 or 12 inches pressure.

Mr. Geo. Livesey, London, said that with the South Metropolitan Company the question of high pressure mains arose in this way. They were constantly face to face with the necessity of laying larger mains in order to supply the extremities of their district. They had a good number of large mains going out from their different distributing stations, and the idea occurred to him that they might have some independent mains. For instance, the main that Mr. Carpenter had spoken of was an independent main laid to Clapham Junction. It was laid for the purpose of helping the supply there, it being a rather low district where there was a large consumption. The size of the main was——

Mr. Carpenter—24 inches at the start and 18 inches at the end.

Mr. Livesey said they found that they could make it absolutely independent, and the idea therefore was to put the gas into this main at high pressure and deliver it straight into the district where it was wanted. This plan was more effective than they had anticipated. It backed up the governors supplying the Kensington station and got the Company completely over the difficulty they were in with regard to Clapham Junction and they gave still the amount of pressure that was necessary. The idea at first was to have an ordinary blower, but that seemed too cumbrous, and one day passing through Queen Victoria street he saw this Sturtevant blower. Mr. Carpenter was sent to make arrangements, and within a fortnight the necessary appliances were obtained and the blower was put into operation. That showed how quickly and how easily it might be done. His first idea was to have a by-pass and all that bother. He mentioned it to Mr. Carpenter, who said there was no governor necessary as it was a free and open blower, and, if stopped, the gas would flow through without any difficulty, just the same as if it was an ordinary main. Their intention was to make use of independent mains for supplying pressure throughout the districts. They had certain mains which they could make independent for several miles, and these would be utilized for delivering gas at high pressure into the extremities. Then the system had another great advantage. By the introduction of big gasholders they were in this difficulty, that when the outer lift was empty there was not pressure enough to supply the extremities; in other words, with a storage of 45,000,000 cubic feet they had from 10,000,000 to 15,000,000 cubic feet, which was of very little use to them. On days when there was a heavy demand for gas the outer lifts were empty at 7 or 8 o'clock, and the inner lifts had not pressure enough to supply the districts, so that the remaining 10,000,000 or 12,000,000 cubic feet of storage was of no use. But by adopting the plan of putting one of Sturtevant's blowers on the gasholder leading to the governors they could put what pressure they liked on the governors and thus convert a low pressure into a pressure sufficient to supply the district. He suggested to Mr. Carpenter that he should read a paper at this meeting on the subject, but it was finally thought better to wait until they had had the experience of next winter.

Mr. G. C. Trewby, London, said the whole of the Beckton gas had to be pumped up to London. When the works were laid out they were laid out with one 48-inch main, but all the pressure they could give was the gasholder pressure of about 6 inches. In the course of a year or two it was found that that pressure was not sufficient in London, and then exhausters were put on and the gas was pumped up. Now they had a second 48 inch main. He did not know whether he should alarm them if he stated that it was no uncommon occurrence in the winter time to put 24 inches pressure on the mains at Beckton in order to get a sufficient pressure in London. The whole of their works were connected together by this high pressure system with the exception of Kensal Green which stood alone. Of course, the advantage of this system was that the works having a district apportioned to them more than they could supply had simply to draw their supply from the Beckton main, and put it either directly into the districts or through their holders. As far as he was personally concerned he did not know why they should stop at 24 inches pressure, because 24 inches on the main was a mere nothing. He did not see why they should stop under 48 inches, as the leakage was not in direct proportion to the pressure. Considering that they had this large system of distribution under high pressure all through their district, there was very little unaccounted-for gas. All their gas was corrected to 60°, so that they had the additional disadvantage, as some people thought, of not accounting for the whole of the gas by about 2½ per cent.; and if they looked to the amount of unaccounted-for gas they would find that it was not more than it was in the general run of such undertakings throughout the country. He would like to ask Mr. Stevenson if he had any particulars with reference to the cost of pumping gas per thousand cubic feet. He had occasion to take his own figures out some time ago, and the whole cost of the pumping came to about 0.2d. per 1,000 cubic feet. When it was considered that they were more than doubling the capacity of the main there certainly seemed to be a very great economy in this method of distribution.

Mr. W. Foulis, Glasgow, asked whether the gas under the 24-inch pressure was delivered into the mains or only into gasholders.

Mr. Trewby said that at the town end it was distributed, through the governors, into the distributing mains or into holders, as required.

The President said he took it that the 24 inches pressure was due to the friction of the main; it was not gasholder pressure.

Mr. Foulis said he might mention that at one of his works, for many years, they had sent out in the winter about 1,000,000 cubic feet an hour through two high pressure mains, one being about 3 and the other about 2 miles long. The gas was distributed through governors. The discussion would certainly be very useful to him, because he was just contemplating putting down another 4-feet main right into the town, but if he could manage it by putting on a small blower, as Mr. Carpenter had done, he thought it would be more economical.

Mr. W. R. Herring, Edinburgh, thought the question of high pressure distribution was one which must have occupied the minds of most of those present. At the present time the roads were so much occupied with electrical lines and cables for tramways, and so on, that there was little room left for gas mains, and they would, therefore, have to devise some means of distribution other than by low pressures. In Edinburgh their gasholder stations were scattered throughout the district and they had to be supplied by means of exhausters from the various works. It had recently become necessary to lay some large mains into new districts, and a difficulty arose as to getting the main through because it would have to pass through the heart of the city. He found that they had a high pressure main of 24 inches supplying gasholders passing near a spot where they could make a junction, and it occurred to him that they might put in an underground govornor at that point. This they did, and by this means they supplied a 15-inch main. The pressure in the district was now most uniform, and the governor was quite a success. The pressure on the governor was controlled from the works from which it was probably three-quarters of a mile distant. He believed the system was capable of enlargement, and in his own particular case they would be compelled to extend it under the new conditions. Their works would be at the extreme corner of the district, and the trunk main going to some gasholder stations would no doubt be utilized to supply district governors. Instead of taking the pressure pipe back to the works, he should propose to have a cottage on the road and allow a man to live in it to look after the pressure changer. His duty would be to actuate the governor. He was sure that such a system would save a considerable outlay in the distribution of gas in the future.

Mr. Thomas Glover, West Bromwich, said he did not think the discussion would be complete without mentioning that an apparatus had been devised for controlling pressure by electrical means from the works. Such an apparatus would, he thought, lend itself to high pressure distribution. A constant pressure on the low pressure mains was very desirable for the consumers.

Mr. Chas. E. Botley, Hastings, said he would like to say a word on the question of the equalization of pressure throughout a district. At Hastings they had a system of high pressure distribution without any mechanical means. When he mentioned that some parts of the district were 650 feet above the sea level, and that some were below ordnance datum, it would be understood that it was a difficult matter to distribute gas at an equal pressure over the whole of the district. That difficulty had been overcome to a great extent. In the day time there was an excess of pressure on the hilly parts, but at night time, when the consumption increased and the draught of gas came on, it was found that the pressure was fairly equalized. Hastings might be described as a sea front with a number of valleys running up to a table land at the back; of course, with side valleys in between on rising ground. It was all ups and downs and a mixture of hill and dale all over the place. But by reducing the size of the mains as they rose, a fairly equal pressure was maintained throughout the whole of the district. He had found it of advantage at the extreme ends of the district, instead of putting down what would be considered an ordinary sized pipe for supplying the quantity of gas required there, to put in a large pipe so as to form a kind of nucleus of gas which made a cushion for the incoming gas to work against, and this helped to keep the pressure constant. Continuous tests of the pressure had been made during the past winter, and it was surprising to find within what a few tenths the pressure could be maintained throughout the district by this means without any mechanical appliances and by taking advantage of the natural contour of the ground. With regard to the high pressure mains that had been spoken of, one would like to know whether the high pressure did not tend to impoverish the gas. He himself would think that a pressure of 48 inches would have a tendency to considerably impoverish the gas at the end of the district.

Mr. F. D. Marshall, Copenhagen, asked whether there would be any objection to sucking the gas through the main by means of an engine and exhauster at the far end of the district. He did not mean to suggest that they should produce an absolute vacuum in the main, but he thought gas could be sucked through the main more easily than it could be forced through.

Mr. Stevenson thought that the capacity of the main would be impaired by the sucking.

Mr. Marshall said his suggestion depended on the understanding that the main itself was not used for distributing, but only as a means of drawing gas from the works to an outlying point. The gas might be sucked to this point and then distributed to outlying parts. His friend, Mr. Erminger, was doing what he suggested. He was not able to push the gas through the mains to the point of distribution, but he sucked it from the works, and distributed it through the supplementary stations in a district which he would otherwise be unable to supply. That would get over the difficulty of high pressure in mains which seemed to be rather a bugbear, and which, as Mr. Botley had suggested, might cause loss of illuminating power.

Mr. F. W. Cross, Lea Bridge, said that in 1895, in Edinburgh, he read a paper before the Gas Institute upon the equalization of pressure in Victoria, Hong Kong, where they had adopted the very means which the previous speaker had mentioned. They wished to add to their storage capacity. Not being able to obtain ground round the works they fixed their holder from 2½ to 3 miles away, the ground between being perfectly level, on the sea side. The holder was supplied through the ordinary mains of the district, and there was no special main laid except for a distance of a quarter of a mile close to the new holder connecting the larger mains with the holder. The gas was supplied from the works during the day time at a normal pressure of 10-tenths, and when the new holder was erected they put an exhauster in a house adjoining and drew the gas through the town mains while the consumption was going on, without affecting the consumption in the slightest. The increased pressure required at the works was about three-tenths. Half-way along the main there was a gas engine driving the electrical plant of one of the cable companies, and that engine was never affected, but always had sufficient pressure to drive by while the gas was being sucked through the mains into the gasholder.

Mr. S. Meunier, Stockport, considered that the discussion was one which was likely to be of use to them all. In the Sheffield case and one or two others that had been cited it had been a case of high pressure distribution by special mains which the engineers had fortunately been able to utilize, but it must not be forgotten that unlike the electric light, which was now being laid out in most towns and was a new thing entirely, they could not put out this high pressure feeder with a low tension distributor unless at very great expense. In his own town the only high pressure main in existence was a short length between the two separate works, and it went through the center of the town. But that portion of the town did not need any more supply than it had already got. They had found great difficulties in keeping up the supply to their rapidly growing outlying districts. The mains there had probably been in existence for 20 or 30 years; and they required either enlargement or pressure to keep up the supply to the districts. He was rather pleased to hear Mr. Cross's statement, because in his own case the increase of the supply meant the laying out of a very large amount of money, and cutting up the middle of the town in order to get to these outside places. But if it was possible to put down a drawing apparatus instead of a forcing apparatus, it would perhaps enable them to get over a difficulty which he could not see was to be overcome by high pressure mains. As far as leakage caused by high pressure was concerned, he could only say that he had not noticed anything of the kind in his experience of the last seven years. They had a main a mile or a mile and a quarter long with 12-inches pressure. There was simply gasholder pressure, and they had never had any leakage from it. But he was rather more interested in the other way that had been pointed out of overcoming the difficulty. They could not put separate mains without going to very great expense, and if it was possible to utilize the existing mains by merely increasing the pressure somewhat at the works, and then drawing the gas through, he thought the difficulty would be practically overcome.

Mr. T. S. Lacy, London, said that in the Gas Light and Coke Company they had to regard the whole of their gasholder storage of 100,000,000 cubic feet as common property, as it would be otherwise impossible for them to adjust their supply in the winter. They had holders not only at the works but in other parts of London from which they could not only suck gas in but also pump it out; and as to the question whether the gas was to be pumped or drawn, they did not care which plan was adopted. The use of the blower and the exhauster was a question in which he was much interested. Years ago he said that the gas exhauster was not the proper apparatus to use for low pressures. It was well known to everyone who had experimented with gas exhausters that they did not give any efficiency at any pressure, say, under 15 inches or 20 inches; but when the pressure amounted to about 40 inches with a good gas exhauster they could get a mechanical efficiency of about 80 per cent. When the pressure fell down to 10 inches or 15 inches the whole of the work was simply in the friction of the apparatus. He had no hesitation in saying that a good blower with a pressure of 15 inches or 20 inches would work at less horse power than the best exhauster, and as a matter of mechanical efficiency he did not hesitate to say that they would get more efficiency out of a 10-inch or 15-inch blower than out of the finest exhauster they had. The blower he regarded as the more scientific instrument for pumping gas, because the pumping could be done in two stages. They could go up to 15 inches in one and up to 30 inches in the other, and he did not see why a cheap and compact apparatus might not be used for pumping large quantities of gas. He congratulated Mr. Livesey upon a step which he believed to be in a right and new and sensible direction. Another thing that had struck him, and he thought must have struck them all, was that when a 48-inch main went into a house for distributing purposes, there was no reason why that 48-inch main should be continued inside the building. The connections might be very materially reduced, and the valves might be reduced, and a large saving might be made without in any way sacrificing the efficiency of the plant.

The President said it was very gratifying indeed to find that the subject had created so much interest, and that so many personal experiences of a different character had been brought forward. No doubt the principle of utilizing pressures as a means of increasing the capacity of mains was subject to endless variety in its application. They might have a machine for driving gas through a main under pressure, or they might suck it through a main and deliver it at pressure, or, as Mr. Cross had indicated, if the supplying mains were sufficiently large, they might even extract from them a certain portion of the gas, and deliver it by a blowing or driving machine into another neighborhood. All the remarks that had been made had at any rate shown that no danger was to be feared from the use of high pressure mains, and that was a very important point. As to its economy there could be no question. One great thing was that they should make it more clearly understood that by adopting high pressure—even more than a gasholder pressure—in

certain mains not connected with the distribution, but independent mains, they were not placing the dwellers in the streets in any danger whatever from the undue leakage of gas and possible explosion.

Mr. Stevenson, in reply, said this was one of those cases in which a very short and apparently simple paper had brought forward a great deal of information from members, and this showed the very great use and interest of meeting together for discussion. He had been particularly interested in what was said by Mr. Livesey and Mr. Carpenter as to driving, not by exhauster, but by blower, and the greater quantity of gas that could be put through the main by this means. In his own case, with a 30 inch main, they had only put about 200,000 cubic feet per hour through it, but Mr. Carpenter, with a 24 inch main, had put 300,000 cubic feet through per hour. It had occurred to his mind how, with this 30 inch main, when they were making at Grimesthorpe their full capacity of 10,000,000 cubic feet, they were going to get rid of the gas, but in the face of what Mr. Carpenter had said there would be no difficulty at all, and they would be able to get a far larger quantity through than he had had any idea of. The cost of pumping he could give no information about, but it must be very small indeed. The chief item would be the fuel, which in Sheffield was not very great. If exhausting were resorted to, of course, while they were exhausting, they must keep up the pressure on the mains. If they exhausted a mile of mains, and had to supply a governor while they were exhausting, they would have to maintain a 3-inch pressure, otherwise the main would lose capacity. Sheffield was peculiarly situated with narrow valleys and streams running between them, and the laying of a large main was a work of great difficulty; in fact, in the case of the main street coming from the Neepsend works, it would hardly be possible to get another pipe in, so that they were obliged to get rid of the gas from there under pressure. With regard to altitudes, Mr. Botley mentioned a difference in level of 650 feet, and the system of reducing pressures by small connections to the mains. But that plan he had found to be a mistake in Sheffield. There the works were up about 170 feet, and the district up to rather over 900 feet of altitude. On the hillsides the small mains originally laid caused great pressure. From diagrams taken within the last year or two, it was found that durin, the day the pressure was exceedingly high, and after two or three hours of consumption the pressure in the small mains was sufficiently high. Therefore, the line that he went upon was to lay large enough mains and regovern the gas. He was pleased that there had been such a good discussion and that so much information had been elicited.

The Manufacture of Illuminating Oil at Baku in 1897.

[By Mr. W. Latkin, *Am. Mfr.*]

In 1897 there were in operation at Baku 63 oil refineries, which produced in the first 10 months 7,208,400 barrels of illuminating oil. This quantity exceeds that produced in 1894, but is less than the production in 1895 and 1896. The production of crude has increased by 35 per cent. during the last five years, while illuminating oil shows an increase of only 11 per cent. The difference in the increase is explained by the fact that the sale of residuum, as well as crude oil, from which the more volatile components have evaporated, is more profitable, and that the manufacture of illuminating oil requires a larger capital. The Baku refineries have a capacity of about 60,000 barrels of distillate per day, or 20,000 barrels per year, but other machinery, such as boilers, pumps, agitators, as well as tankage for half-finished and finished product, is not sufficient for the working up of such a large quantity of distillate, so that the maximum capacity of the existing refineries amounts to but little more than 10,000,000 barrels of illuminating oil per year. It is true that the storage facilities are being rapidly enlarged and improved, but their lack is still felt keenly by the oil trade, on account of the inability of the Baku and Batoum railway to handle the large traffic with anything like promptness.

In the production of the 7,208,400 barrels of illuminating oil mentioned, there were consumed 29,173,200 barrels of crude, or 4.04 barrels of crude for one barrel of illuminating oil, as against 3 85 in 1895. The yield in 1897 was, therefore, 24.47 per cent., as against 26 per cent. in 1896.

Shipments of residuum for the first 10 months of 1897 amounted to 21,905,000 barrels, of lubricating oil to 781,000 barrels. With proper working the proportion between residuum and illuminating oil is 2 to 1, but in the period mentioned it was only 3.09 to 1. The increase in residuum amounted to 59 per cent., which shows at the same time the deterioration of this product, as more easily ignitable components are allowed to remain in it.

The continuous distilling method has made further progress during the past year. In the Noble refinery itself there are three batteries of 17 stills each. The crude oil flows into the first still of each battery, and is heated there to 120° C. In the measure as new crude flows into this still, the heated crude passes into the second still, which is heated somewhat higher, and from there it passes to the 17th still, which is heated to about 300°. The properties of the distillate from each still are regulated by the quantity of in flowing superheated steam. The quantity of steam admitted to the first still amounts to about 5 or 6 per per cent. of the quantity of distillate produced here; with the following stills the quantity of steam is increased, until it amounts to 50 per cent. in the last still. The Nobel works have a capacity of 20,000 barrels a day. The other refineries work mostly with batteries of 6 stills each, the latter being 22 feet long, with 8 feet diameter, and a 26-inch fire tube. Such a still will hold 120 barrels, and a battery of 6 stills can work up 3,000 to 3,500 barrels of crude daily. Stills operated with direct firing, and without superheated steam, are growing obsolete, being now used in only one of the smaller refineries.

The high cost of fuel compelled the refineries to take special measures for saving the residuum. In nearly all of the larger factories, it was seen that the simple heating of the crude to about 50°, by allowing the hot residuum to pass through, was insufficient, and an arrangement is now provided whereby preheating is accomplished in two stages. From the last still the residuum first passes into a new preheater, provided with a very extensive tube system, and from there back to the heating tanks proper. All the preheaters are walled carefully in solid brick masonry. The crude surrounding the hot residuum pipes is heated in this manner to 130°. The residuum leaves the second preheater at a temperature of 90°. Some refiners attempted to use the smoke gases from the stills for heating the crude, but the experiment was not successful. At the same time as preheating, the separation of the benzine is accomplished.

It is due to those economics that the cost of fuel has been reduced in properly installed refineries to about 3½ per cent. of the total cost. The delegmators are air coolers, consisting of one to three vertical cylinders, of 12 to 16 inches diameter. The condensate from the single cylinders is not carried back into the still, but is collected separately, which renders it possible to separate the distillates of the single stills into further fractions.

Much has been done to improve the quality of the Russian illuminating oil. The government order, that all petroleum should be examined as to its purity, has proven very necessary, in view of the fact that of the stocks on March 15, 1896, but 559,000 barrels stood the test, while 923,000 barrels proved to be poorly refined. The introduction of the purity test did not result in any changes in the refining process, but it caused an increase in the quantity of chemicals required.

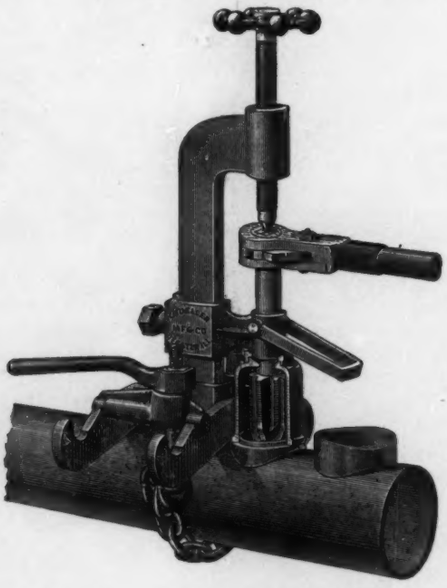
The quantity of sulphuric acid of 65° to 66° Beaume used amounts to .5 to .7 per cent. In the Noble works, where half of the distillate is subjected to a second distillation, the consumption of sulphuric acid is sometimes as low as .33 per cent. Before the acid treatment, the distillate is subjected to a preliminary drying by means of waste acid. Only in a few factories the oil is spray-washed, and then mostly with sea water. In most of the refineries acidification is immediately succeeded by lixiviation, which is accomplished by means of a strong solution of caustic soda, of about 32° to 35° Baume, of which .2 to .3 per cent. of the volume of the oil is used. Some refineries utilize the waste lye for a preliminary lixiviation. Most of the smaller factories consume lye ready for use, as supplied by the regenerating works of Feigl, Tagieff, and others. Only the largest factories, such as those of Nobel Bros., Tagieff, Caspi, Caspi and Black Sea Company, operate with lye as weak as 16° Beaume, and wash afterwards with the water condensed from their steam plants. In the refinery of S. M. Shibajeff & Co. the distillate is treated with lime before its acidification; this method being based on the principle that the lime extracts from the distillate all those substances which do not enter into any combination with caustic soda, and which become yellow and resinous under the influence of air and light.

Petroleum treated with lime is said to possess an exceptionally high flash point, and requires but .1 per cent. of caustic soda for neutralizing after acidification. The lime treatment, however, is connected with considerable difficulty, and furnishes a large quantity of waste, in which much petroleum is enclosed, for which reason the other refineries have not adopted this process. The light consumption of chemicals is explained by the fact that only a small part of the distillate, about 15 to 20 per cent., is worked up to illuminating oil. In this way the loss in distilling and the cost of fuel are also reduced to the lowest possible minimum.

If the price of illuminating oil should rise and refining become more profitable at Baku, so that a higher yield of illuminating oil would appear desirable, the cost of production will also increase. The cracking process, however, can hardly ever be successfully employed together with the purity test, as the most carefully refined petroleum obtained by disintegration or cracking would not stand that test.

The Mueller Dry Pipe Tapping Machine and Pipe End Reamer.

The two devices here illustrated are manufactured by the H. Mueller Mfg. Company of Decatur, Ill. The first has a special attachment for tapping gas mains under high or low pressure. The body of the machine is made of malleable iron to fit a pipe or column of any size. The yoke holding the feed screw is made of steel. This yoke is driven into the body and securely riveted, thereby making it very rigid. The feed screw is made of steel with a tempered point. The tool guide is made of malleable iron and holds the tool in the center of the pipe in perfect line with the feed screw. This relieves the feed screw from all side strain caused by pulling on the ratchet. The tool guide is held in place by a thumb screw, thus allowing the tool to be removed by releasing the screw and raising the guide. The 16-inch reversible ratchet is of the strongest construction, being made of steel and malleable iron. The wheel and dog in it are made of steel drop forged, finished and then tempered. Every piece of the machine and ratchet is finished by automatic machinery to templet, thus making it possible to duplicate every



part. The special attachment above referred to consists of a brass cap which fits over the shank of the drill and tap, and which is provided with a beveled leather washer in the top so as to make a perfect packing around the shank of the tool, and a hard rubber saddle at the bottom which makes the joint next to the pipe.

To operate, the machine with tool and cap is placed on the pipe and bolted securely. The swinging yoke on the tool guide should then be brought in position under the feed screw and forced down by it, thus compressing the leather washer and the rubber saddle, after which the set screw in the tool guide should be tightened. The swinging yoke can now be pushed down and the ratchet handle placed on the tool ready to make the tap. After the tap is made the machine is loosened and pushed to one side, and the pipe is inserted in the usual manner. With seven saddles, pipes from 3 to 60 inches in diameter can be tapped.

The pipe end reamer, shown in the second engraving, is intended for reaming out the burrs from the ends of wrought iron and steel pipe. It is furnished in two styles—namely, one with ratchet mechanism, as illustrated, and the other without the ratchet. The tool consists of a tapering malleable iron frame with three slots for holding the cutting knives, the ratchet handle and the brace handle. The steel knives are held in place by a cotter pin and center guide, and each knife does its share of the cutting, even though one be ground off more than another. These cutting knives are made of tool steel, specially tempered, and the ratchet parts are made of cast steel. The strain on a ratchet used with a tool of this nature is quite light, but at the same time the strain is here divided into half a dozen or more bearings instead of placing it on one bearing, as is the case with the ordinary ratchet. The working parts of the ratchet are entirely concealed, so that no dirt or foreign matter can interfere with its operation. With the exception of occasionally replacing a cutting knife this tool should last for many years. This reamer will remove the entire burr and not spread it. It will ream any size of pipe from $\frac{1}{8}$ inch to 3 inches inclusive.

Mechanical Draft.

[By Mr. Walter B. Snow, before the Northwestern Electrical Association.]

The substitution of the fan for the chimney as a means of draft production marks a distinct advance in the convenience and economy of steam generation. It is, therefore, fair to assume that a discussion of mechanical draft must be of particular interest to all who are concerned in central station management. Although the advantages of many improvements are to be viewed solely in their direct commercial relation, such is not the case with mechanical draft. Not only does its application insure an evident economic gain, but in both its installation and operation there are certain conveniences which are to be considered as distinct advantages although it may be almost impossible to determine their definite economic values.

Mechanical draft may, in stationary practice, be applied in either of two ways: First, by forcing the air into a closed ashpit, and maintaining therein a pressure in excess of the atmosphere, and second, by exhausting the air and gases from the flue or uptake and thereby creating a partial vacuum which causes a constant inward flow of air in the combustion chamber. The former is designated as "forced draft," and the latter as "induced draft." Under certain conditions a combination of the two methods may be found desirable. The natural result of the application of a centrifugal fan in either manner is to render the draft conditions positive at all times. A fan of the disk or propeller type is entirely inadequate for such work.

On the erection of a chimney the first matter to receive consideration is the foundation. This always represents a comparatively large, and in the case of unstable ground, an abnormally excessive proportion of the expense of the entire structure. A fan on the other hand is relatively light, requires no expensive foundation, and may in many cases be located upon the top of the boilers. Not only does this vastly reduce the cost of installation, but it furthermore lessens the space required, which is always a definite character in the case of the chimney, but with a fan placed overhead is entirely eliminated.

The portable character of a mechanical draft apparatus renders it not only valuable as an available asset, when it is no longer required in a given location, but makes possible its relocation or arrangement in a manner that is absolutely impossible in the case of a chimney, which must always stand as a monument to a departed industry or an abandoned means of draft production.

The primary duty of the chimney is to create sufficient draft, while its secondary office is to remove the gases and smoke to a proper height for discharge to the atmosphere. The height required for this purpose is almost universally less than that necessary to produce the draft. Obviously, a stack of decreased height and cost will serve the purpose with mechanical draft. In fact, a sheet iron pipe extending but a few feet above the top of the boiler house will in most cases fulfill the requirements.

The steel plate construction which is common to most fans employed for producing draft makes it possible to readily design and build them to exactly suit any given conditions. Such a fan may be arranged to be driven by a belt or by a direct connected engine, as may be desired, may be automatically controlled in its speed to meet the requirements of steam generation, and may be increased in capacity by the simple transmission of more power.

In operation, mechanical draft is both positive an flexible. Its positive character renders its action independent of the weather and its flexibility lends to it that characteristic so lacking in the chimney, the ability to exactly adapt the intensity of the draft as well as the volume of air to the existing requirements. How much those two elements of simple convenience mean in the generation of steam for electric traction work can only be realized by one who has experienced the sudden and immense fluctuations incident to such service. The fan is always at its best, can be instantaneously pushed to its utmost and does not have to wait for hotter fire to produce stronger draft. When properly installed, such a fan should be provided with an engine devoted solely to its driving, and the speed of this engine should be so controlled by devices that are readily applied, as to increase its speed in proportion as the steam pressure falls. It is thus possible under all ordinary conditions to maintain practically constant steam pressure and to insure immediate response to sudden demands.

Another feature of convenience resulting from the employment of mechanical draft is to be found in the ability to burn cheap fuels which are almost invariably of small size and require an intensity of draft which is not readily created by means of a chimney. The economic value of this and the preceding features of convenience will be considered as we proceed.

The "smoke nuisance" is in many of our communities receiving the attention that it properly deserves. In practically all devices which have proved successful in the prevention of smoke, improved draft has been a most important factor and the positiveness and intensity of the draft produced by a fan have assured the success which has attended its application.

We may now turn to the distinctly economic aspects of the installation of mechanical draft, and of necessity these must be considered relatively to those incident to the use of a chimney. Employed solely as a means of creating air movement, the chimney is most absurdly inefficient. It may be readily shown that under the ordinary conditions of boiler practice an engine driven fan will move a given amount of air with the expenditure of about one seventy-fifth as much power. This immense advantage of the fan over the chimney may be turned to good account by introducing proper devices for transferring the heat of the gases to the feed water or to the air supplied to the fire, and the gases may, with fan draft, be cooled to a temperature far below that which could be attained with a chimney without too seriously reducing its draft.

Custom and the expense of high chimneys are, doubtless, responsible for the comparatively low combustion rates which prevail in most steam plants. It may be fairly stated that to double the rate of combustion on a given grate area, it is necessary to make the chimney about three times as high, at a cost, perhaps, five times as great. In the case of a fan the same result could be obtained without even so much as doubling the cost.

Low combustion and evaporation rates are not essential to high efficiency. Within reasonable limits the higher the rate of combustion, the less is the volume of air required per pound of coal. The fire is of necessity deeper, the draft is stronger, and each individual particle of air has increased opportunity to come in contact with the fuel. With a decreased supply of air the intensity of the fire is increased, its temperature is higher, more heat is radiated to the exposed boiler surfaces and more is taken up by the gases, which, because of less ultimate volume, move at lower velocity and thus have more time to part with their heat.

When a fan is employed as a means of draft production it may, at comparatively small expense, be installed of such size as to possess a potential capacity which if embodied in the boilers could only be provided at vastly greater first cost with incident larger fixed charges.

The power expenditure for operating the fans should be practically inappreciable in any well designed plant in which provision is made to utilize the exhaust steam from the fan engine.

The most direct saving in operating expense, which may be secured by the introduction of mechanical draft, is that resulting from the utilization of cheaper fuel. Such a plant as previously described would, under good conditions, probably, require at least 8,000 tons of high grade coal per year, operating ten hours per day. If a saving of only 25 cents per ton could be effected it would represent an aggregate of $2,000 per year, a pretty good return on an investment of $3,500. But in many cases much greater savings may be brought about. A case in point is that of the United States Cotton Company at Central Falls, R. I., where, with a 1,000-horse power boiler plant, the fuel originally employed with chimney draft was George's Creek, Cumberland, costing $4 per ton. With forced draft, a mixture of No. 2 buckwheat screenings and Cumberland is now used, costing $2.62 per ton. The saving has been about $125 per week, enough to pay for the special steam fan in about six weeks.

Other direct and indirect advantages of mechanical draft might be presented, but the limits of the paper will not permit. If it were not for its rough-and-ready character, the chimney would long ago have been discarded, because of its wastefulness. In the search for the highest efficiency such waste can no longer be ignored, and when dollars and cents are concerned crude methods must give way to those of greater refinement. It is for this reason that the most progressive engineers of the present day are not only considering, but adopting mechanical draft as a substitute for the chimney.

In the discussion which followed the reading of this paper, Mr. Doherty pointed out the saving effected by the use of electrically driven feed pumps. He also referred to electrically driven fans for creating the mechanical draft and said that the latter must be crowded in order to give efficient service. He also discussed the relative economy in the use of economizers and recuperators, and he declared himself to be rather in favor of the latter. He commented highly on Mr. Snow's reference to the prevention of the smoke nuisance by the use of mechanical draft.

Mr. Dow made a few remarks about the advantages of using a thick layer of fuel rather than a thin one, as the former produces the appearance of carbonic oxide and reduces the amount of air enormously. These arguments were refuted by Mr. Doherty, who stated that he has seen thin beds produce considerable carbonic oxide and at the same time a large quantity of free oxygen.

Mr. Cross, the reader of the paper, in the absence of the author, closed the discussion by expressing the opinion that mechanical draft, economizers and automatic stokers might be all right for large central stations, but small stations could make steam just as cheap without any of them, if you count in the interest charges on the extra investment. He believed, however, that mechanical draft might decrease the investment.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. ALBERT F. JENKINS, son of Mr. E. H. Jenkins, of the Buffalo City (N. Y.) Gas Company, has been appointed Superintendent of the Athens (Ohio) Gas and Electric Company.

"OBSERVER" forwards the following budget, under date of June 27th: "The Legislature of Massachusetts has adjourned; but its record, so far as gas legislation is concerned, has not equaled even that of the fabled mountain which brought forth the mouse, for it has brought forth nothing. Yet there is much to be said on the side of the merit of no legislation, and perhaps in this light there is much to be thankful for. The honest gas man and gas consumer hoped early in the session, when the various bills for the regulation and restriction of companies which were not doing, 'to put it mild,' a strictly legitimate business, that the situation would be cleared up and that the various companies of the State would be relieved of the odium attached to them because some few were having dealings about which there was considerable question. This hope later grew when the Commission in its term recommended a series of bills to remedy evils already existing and to prevent the introduction of others in the future. But they were doomed to disappointment, for all legislation in this direction failed, and matters remain practically as they were a year ago. The arguments used to influence legislation were many and various. Perhaps the funniest one was the appeal to patriotism, for it was conceived possible, if no outlet for Dominion coal was found in the Massachusetts Pipe Line scheme, it might be sold to Cervera to coal his Spanish

squadron in its attack on the New England coast. That one was as fanciful as the other goes without saying.——The usual New England party left Boston a couple of weeks ago, for the annual outing at Moosehead Lake. The party was small, but select; the fun and fishing of the very best. The trip was most enjoyable, and all returned safe, brown and hearty, and ready for another year's grapple with the intricacies of the gas business.——Mr. Forrest E. Barker, the present Chairman of the Massachusetts Board of Gas and Electric Light Commissioners, was again reappointed by the Governor, on June 22d. Mr. Barker has served longer on the Board than any other member, having been continuously a Commissioner since the establishment of the Board by the State in 1886, being renominated at the expiration of each term. He is a lawyer by profession; but, by contact with the engineers of this and other countries, has acquired an intimate knowledge of the gas business in all its details; and it may be fairly said, without injustice to the other members of the Commission, that much of the success of the Board has been due to his tact and good judgment. That the work of the Board is approved is shown by the fact that the Legislature just adjourned broke its established precedent and voted to increase the salaries of the Commissioners from $2,500 to $3,500, and raised the salary of the Chairman to $4,000, from $3,000 per annum."

THE proprietors of the Lansing (Mich.) Gas Light Company are making many main extensions. The Company agrees to lay a service pipe from the street main to the meter, without charge therefor to any resident who wishes to try gas for any purpose whatever.

THE Board of Directors of the Quincy (Ills.) Gas Light and Coke Company have perfected the following executive organization: President, Capt. William Steinwedell; Vice-President, H. F. J. Ricker, Sr.; Secretary, Frank A. Parker; Superintendent, W. E. Steinwedell. The change in the management outlined in the above list was occasioned by the retirement of Major A. W. Littleton, who resigned the dual office of Secretary and Superintendent in order to make an extended tour in Europe with his wife and daughter. In selecting his successor the Directors wisely gave recognition to two deserving young men. Mr. Parker, the Secretary, has been with the Company 25 years, having entered its service as a boy, and for whom merit and conscientious attention to duty have won steady promotion. He possesses the confidence of the business community of Quincy in marked degree. Mr. W. E. Steinwedell, the new Superintendent, has just returned from an absence of three years, one of which was spent in the Chicago University, where he studied closely the chemistry of gas manufacture. The balance of the period named was spent in Europe, where he was occupied in the construction of the complete new plant of the German Continental Gas Association's Erfurt property. He is a talented gentlemen and is eminently qualified to succeed his earliest mentor in the gas business—the accomplished, whole-souled "Gus." Littleton.

MR. WILLIAM A. COOMBS, President of the Coldwater (Mich.) Gas Light and Fuel Company, died at his home in Coldwater on the morning of June 19th. Deceased, who was in his 58th year, was a very prominent flour miller (at the time of his death he was President of the National Millers' Association), and was also largely interested in the Tappan Shoe Factory Company.

WE are informed that the affairs of the late Mr. Coombs will be carried on or administered under the direction of the "Wm. A. Coombs Estate."

THE Henry G. Thompson Company, of New Haven, Conn., has been organized to manufacture "gas meters and other machinery." It is capitalized in $50,000, and the parties chiefly interested are Henry G. Thompson, Samuel G. Mower and H. Grant Thompson, all of New Haven.

MR. DUNCAN JONES, Secretary of the New Orleans Gas Light Company, has notified the shareholders that a dividend of $2.50 per share is payable on and after the 15th inst.

W. H. NORRIS, the gas maker in the works of the Waterloo (Ia.) Gas and Electric Light Company, is suffering from injuries caused by an ignition of naphtha in the generating room.

THE Passaic (N. J.) Lighting Company proposes to extend its mains to and through the outlying borough of Franklin.

THE Delaware County Gas Company, of Chester, Pa., has moved into its new and handsome office quarters, which adjoin the building of the Chester National Bank.

AT the annual meeting of the Burlington (N. J.) Gas Company, the officers chosen were: President, Dr. J. Howard Pugh; Secretary and Treasurer, Joshua Taylor; Superintendent, Edward Morris.

THE Hebraic contingent who proposed to give cheaper gas to the residents of Birmingham, Ala., through the old-time medium of an opposition Company, were recently asked by the Council why it was they were sos low in commencing the work of construction. The answer returned is appended: "The petition of Sol. Haas and Alex. T. Loudon respectfully shows unto your honorable body that, on account of the disturbance of the financial markets of the country caused by the outbreak of the war with Spain, your petitioners were greatly hindered in perfecting their arrangements for the construction and installation of the new gas plant, for the building and operating of which a franchise was granted to your petitioners by your honorable body. And your petitioners therefore ask that they be granted an extension of 90 days within which to make their arrangements and begin the prosecution of the said works. Your petitioners represent and state that if said extension of 90 days is granted that your petitioners verily believe that all the necessary arrangements will be made and said works prosecuted to a successful termination. And your petitioners, as in duty bound, will ever pray."

AT the annual meeting of the Exeter (N. H.) Gas Light Company the following officers were elected: Directors, Odiorne Swain, A. Parker Browne, Nathaniel W. Pierce, Edward Hatch and William Burlingame; Treasurer, A. P. Browne; Clerk, Arthur F. Cooper.

THE Directors of the Redding (Cal.) Gas Works have petitioned the Superior Court for the dissolution of the incorporation.

THE new management of the Trenton (N. J.) Gas Light Company have elected Mr. William S. Hancock to the Presidency. Mr. Thos. S. Chambers it is likely will be elected Secretary and Treasurer. The Superintendent named by the Company is Mr. Wilder F. Lawrence, who has been for some years under Mr. C. H. Nettleton in the works department of the Derby (Conn.) Gas Company.

THE new holder for the Seattle (Wash.) Gas and Electric Company will be constructed by the Stacey Manufacturing Company, of Cincinnati, Ohio. Its estimated retaining capacity is 800,000 cubic feet.

THE Newark (N. J.) *Advertiser*, of June 25th, had this to say: "A petition was made before Judge Lippincott, in the Supreme Court, at Jersey City to-day, by the legal representative of a syndicate that controls a majority of the stock of the Oxy-Hydrogen Gas Company. The petitioner asks for an order for a meeting of the stockholders of the Company for the purpose of electing a Board of Directors. Justice Lippincott granted a rule returnable in two weeks and directing the taking of testimony to begin upon two days' notice on the part of the petitioners. This action is the first legal move in a legal battle between the old gas companies operating in New Jersey and the new syndicate recently formed under the charter of the Oxy-Hydrogen Gas Company. Former Attorney General Stockton, of Trenton, made the argument on behalf of the petitioners. He submitted affidavits, one of which was signed by his clients, who hold 275 of the 500 shares of the Company, declaring that they desired a meeting and election. Another affidavit stated that the last meeting was held in 1885, that the stockholders requested Eugene Vanderpool, President, to call a meeting in May, that he complied with the request, but that it was impossible to hold the meeting by reason of the refusal of H. C. Kelsey, one of the surviving directors, to remain. Two objections were raised by counsel for Mr. Kelsey, who opposed the granting of the petition. They held that the Oxy-Hydrogen Gas Company had no legal existence in fact; that its charter was void, and that no meeting could be held."

AT the last special meeting of the shareholders of the Nashville (Tenn.) Gas Light Company a dividend of 3 per cent. was declared, and it was also determined that the dividend rate hereafter should be at 6 per cent. per annum until the Company is entirely out of debt. The proposition to increase the capital stock in the sum of $60,000, the stock to be offered to holders of record at par, was indorsed.

A MAN named Armstrong is putting in a plant, for the distribution of acetylene gas from a central station, in Milford, Pa. The Crissman House and the Bluff House, at Milford, also have separate acetylene gas plants. Let us hope the summer boarders in Pike county's prettiest summer resort will not experience in their vacation frolics any undue elevation consequent upon an explosion.

THE Kansas City, Missouri, Gas Company is having trouble from misfit plumbers.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

MONDAY, JULY 4, 1898.

The Market for Gas Securities.

There was no change in the price of Consolidated during the week, which opened this morning at 196 bid, offered at 199. We believe it is positively safe to purchase Consolidated at anything under 200, with the understanding that a profit of 15 points will be made on such purchase within a month. Old Equitable shares are 206 to 215, and Mutual is 340 bid. A fractional lot of Mutual sold this week at auction at 330. Standard issues are quite out of line with the rest of the city market, a lower scale prevailing in them. New Amsterdams are in some demand, at better figures.

Brooklyn Union is easier, the rate to-day being 122 to 124. Baltimore Consolidated is offered at 64½, with the prospect of at least 70 in store for it. Well defined stories are to the effect that important buying for a strong interest is on in this stock. Peoples, of Chicago, is active, and some inquiry for Consumers, of Jersey City, is at hand. The promised movement in Bay State is still promised.

Gas Stocks.

Quotations by Frederic B. Cochran & Co., Brokers and Dealers in Gas Stocks.

20 AND 22 BROAD STREET, NEW YORK CITY.

JULY 4.

☞ All communications will receive particular attention ☜ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$36,230,000	100	196	199
Central	500,000	50		..
" Scrip	220,000	..	100	.
Cental Union, Bonds, 5's	3,000,000	1,000	99½	100
Equitable	4,000,000	100	206	215
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	500,000	100	340	345
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
New Amsterdam Gas Co.	13,000,000	100	31½	32
Preferred	10,000,000	100	75¼	76
Bonds, 5's	11,000,000	1,000	102¼	102¾
Northern	150,000	50		
" Bonds	150,000	1,000	..	
Northern Union, Bonds, 5's	1,250,000	1,000	94½	95½
New York and East River	5,000,000	100	81	84
Preferred	2,000,000	100	112	115
Bonds 1st 5's	3,500,000	1,000	110	112
" 1st Con. 5's	1,500,000	..	105	107
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	138¾	140
Preferred	5,000,000	100	152	157
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	122	124
" " Bonds (5's)	15 000,000	1,000	115	115½
Bay State	50,000,000	50	8⅛	8⅝
" Income Bonds	2,000,000	1,000	..	75
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	..	92
2d " " "	3,000.000	1,000	70	..
Buffalo City Gas Co.	7,000,000	100	23½	24½
" " Bonds, 5's	7,000,000	1,000	91½	92
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650.000	1,000	104	104¼
Columbus	1,069,000	.	89	91
1st Mortgage	1,085.000	..	101	103½
Consumers. Jersey City	2,000,000	100	75	80
" Bonds	600,090	1,000	100	103¾
Cincinnati G. & C. Co.	8,500.000	100	201	202
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	.
Consolidated, Baltimore	11,000,000	100	..	64½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000.000	..	..	..
Equitable, 1st 6's	910.000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit	4,000,000		58	58½
" Con. Bonds	4,312,000	..	9⅜	90
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	75	80
" Bonds	2,000,000	..	88	91
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	78	83
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	51¾	..
Preferred	2,500,000	100	92	93
Bonds	9,034,400	1,000	104½	105
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	252	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	99⅛	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	94	94½
St. Paul Gas Light Co.	1,500,000	100	49	51
1st Mortgage 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	2,500,000	25	17	18
Bonds	1,000 000	..	94	97
Washington, D. C	2,000,000	20	250	.
Western, Milwaukee	4,000,000	100	88	90
Bonds, 5's	3,556,000	.	102	104
Wilmington, Del.	550,000	50	200	

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Gas Engineer's Pocket-Book 18

DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., 815 DREXEL BUILDING, PHILA., PA., June 23, 1898.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable on July 15, 1898, to stockholders of record at the close of business June 30, 1898. Checks will be mailed.

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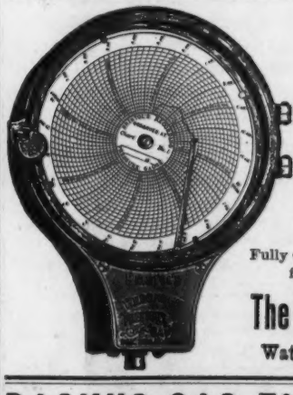

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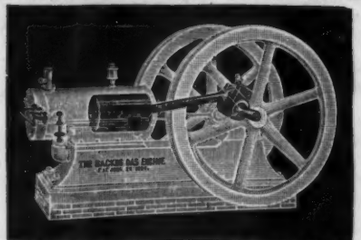

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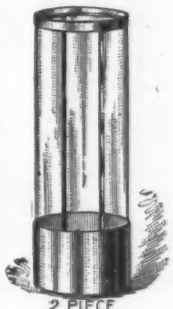

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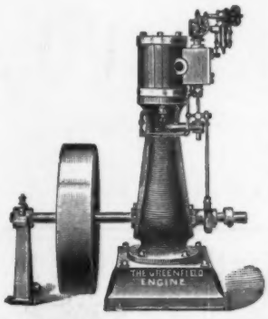

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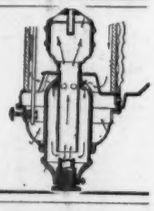

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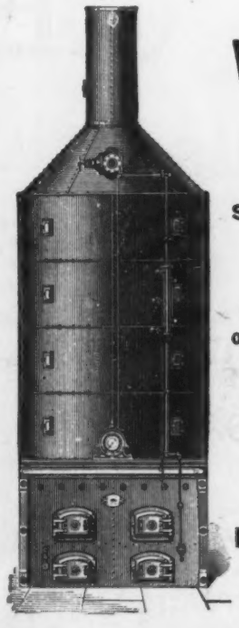

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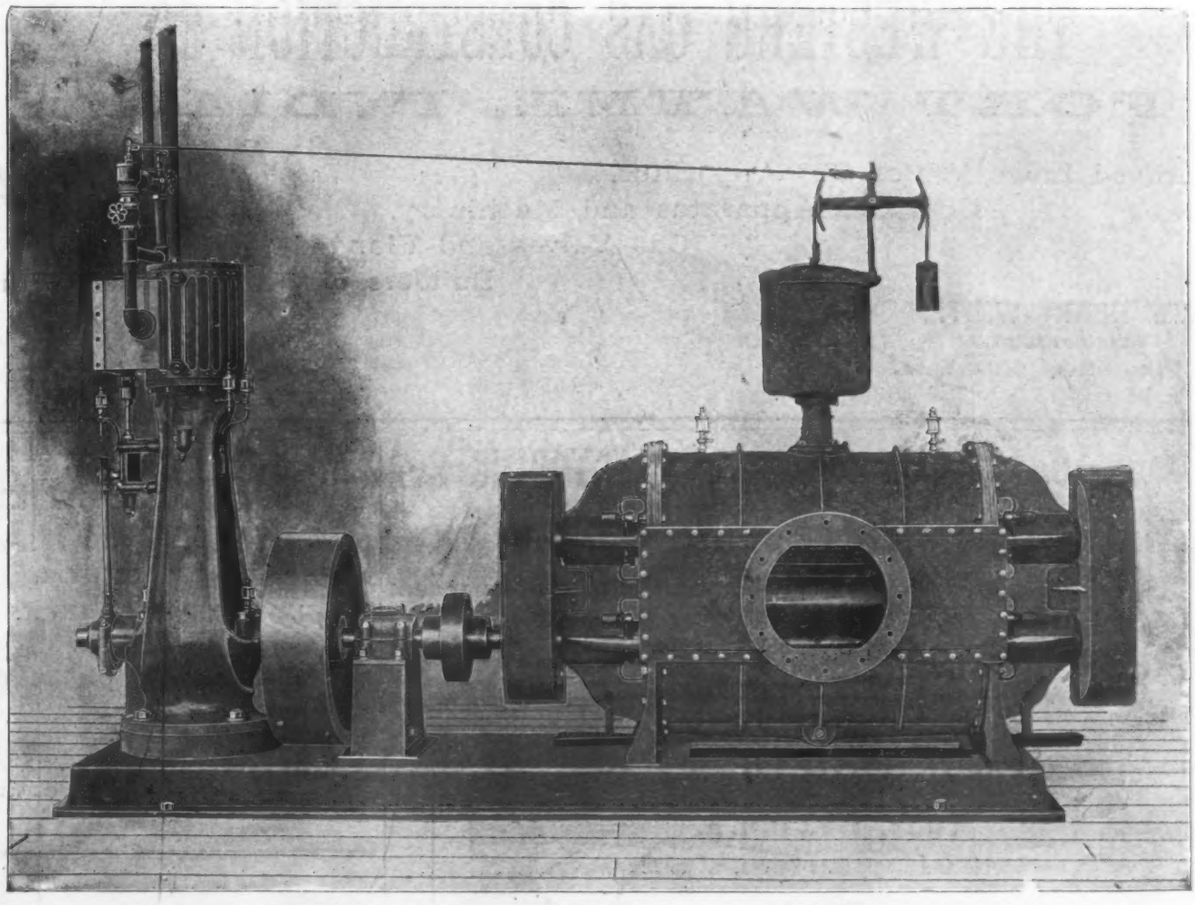

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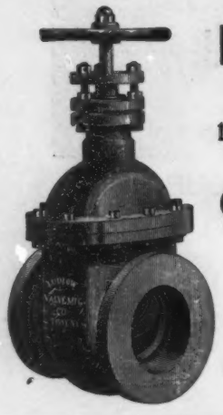

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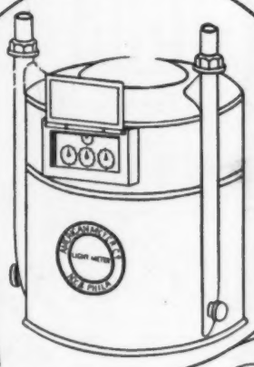
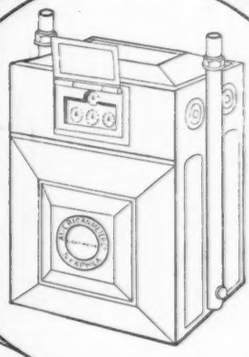
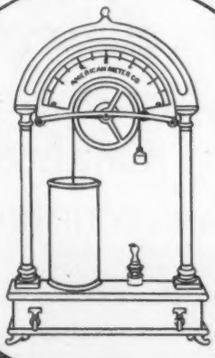
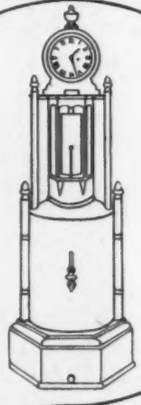
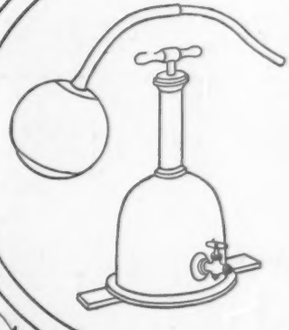






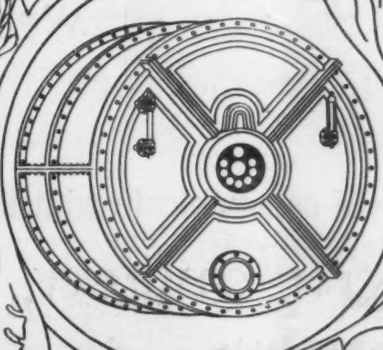


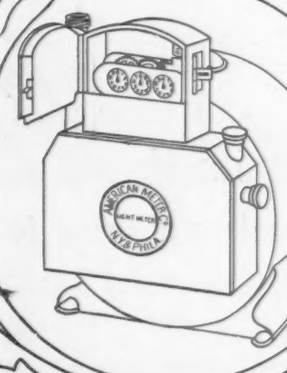


PUBLIC LIGHTING TABLE.

JULY, 1898.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Fri.	1	1.50 AM	3.30 AM	7.30	3.15
Sat.	2	No L.	No L.	7.30	3.15
Sun.	3	No L. FM	No L.	7.30	3.15
Mon.	4	No L.	No L.	7.30	3.15
Tue.	5	8.00 PM	10.00 PM	7.30	3.15
Wed.	6	8.00	10.30	7.30	3.15
Thu.	7	8.00	11.00	7.30	3.15
Fri.	8	8.00	11.20	7.30	3.15
Sat.	9	8.00	11.50	7.30	3.15
Sun.	10	8.00 LQ	12.10 AM	7.30	3.15
Mon.	11	8.00	12.40	7.30	3.15
Tue.	12	8.00	1.20	7.30	3.15
Wed.	13	8.00	2.00	7.30	3.15
Thu.	14	8.00	2.40	7.30	3.15
Fri.	15	8.00	3.40	7.30	3.15
Sat.	16	8.00	3.40	7.20	3.15
Sun.	17	7.50	3.50	7.20	3.15
Mon.	18	7.50 NM	3.50	7.20	3.15
Tue.	19	7.50	3.50	7.20	3.15
Wed.	20	7.50	3.50	7.20	3.15
Thu.	21	7.50	3.50	7.20	3.15
Fri.	22	7.50	3.50	7.20	3.15
Sat.	23	8.30	3.50	7.20	3.15
Sun.	24	9.00	3.50	7.20	3.15
Mon.	25	9.30	3.50	7.20	3.15
Tue.	26	10.00 FQ	3.50	7.20	3.15
Wed.	27	10.40	3.50	7.20	3.15
Thu.	28	11.30	3.50	7.20	3.15
Fri.	29	12.40 AM	3.50	7.20	3.15
Sat.	30	1.50	3.50	7.10	3.30
Sun.	31	No L.	No L.	7.10	3.30





TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45

Welsbach Patent Sustained.

INJUNCTION GRANTED.

Judge Townsend, in the United States Circuit Court for the Southern District of New York, has handed down a decision sustaining the Welsbach Light Company's Rawson patent, and adjudged **THE SUNLIGHT INCANDESCENT GAS LIGHT COMPANY** to be an infringer. This Company has been enjoined from the further use of its method of manufacture of incandescent mantles or the sale or use of the same, and ordered to render an accounting.

A further decision has been handed down by Judge Lacombe in the United States Circuit Court, granting a motion for a similar injunction against **THE REX INCANDESCENT LIGHT COMPANY.**

Every other manufacturer of incandescent mantles in the United States is under these decisions an infringer of this patent, and the Welsbach Light Company will proceed against them at once.

We again caution gas companies and the public generally against the purchase of any incandescent mantle other than that made and sold by the Welsbach Light Company or its agents.

Every genuine Welsbach lamp has the trade mark "Welsbach" conspicuously printed upon the package and upon the burner itself.

Dealers desiring to handle the genuine article should communicate with the

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Drexel Building, Philadelphia.

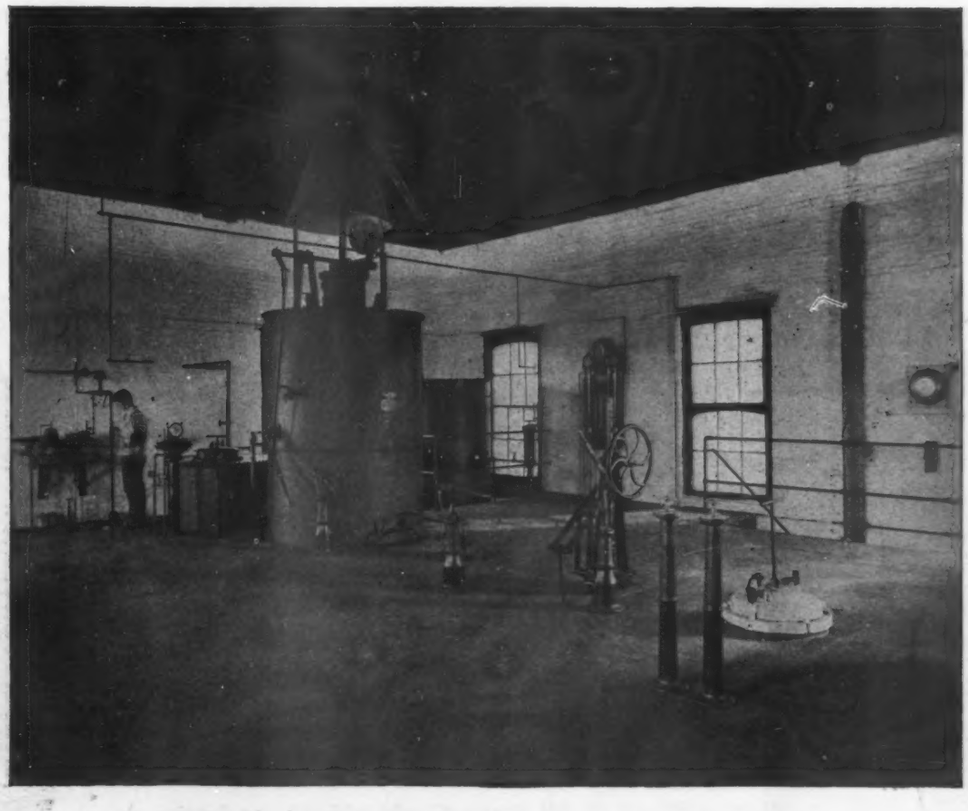
The United Gas Improvement Company,

DREXEL BUILDING, PHILA., PA.

The Standard Junior,

The Standard Double Superheater,

LOWE WATER GAS APPARATUS.



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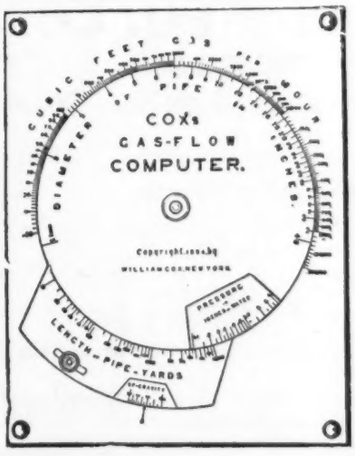

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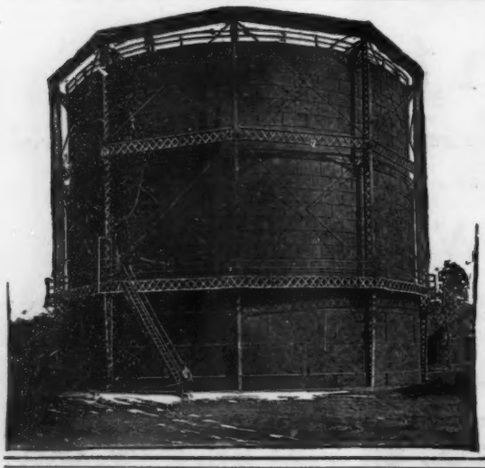

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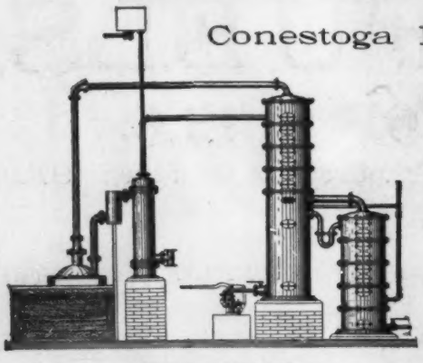

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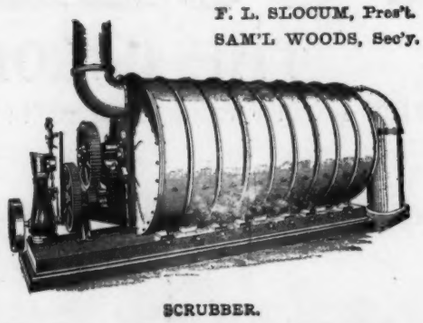

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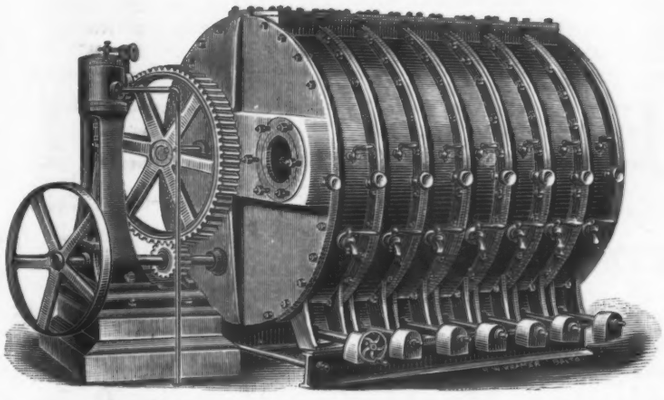

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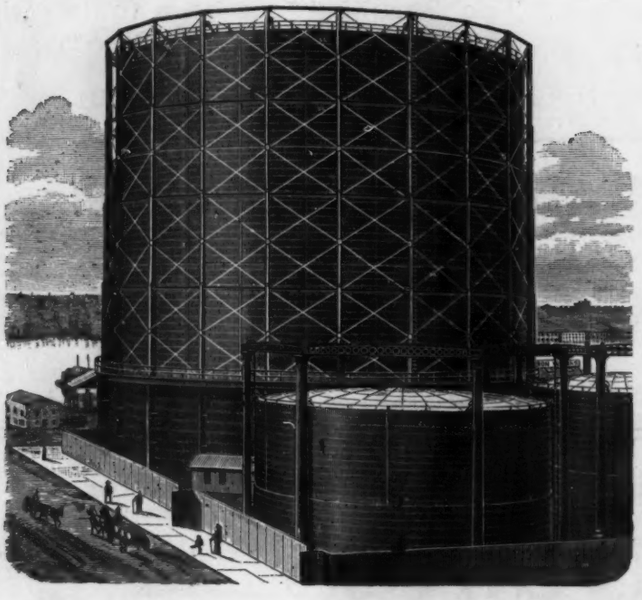

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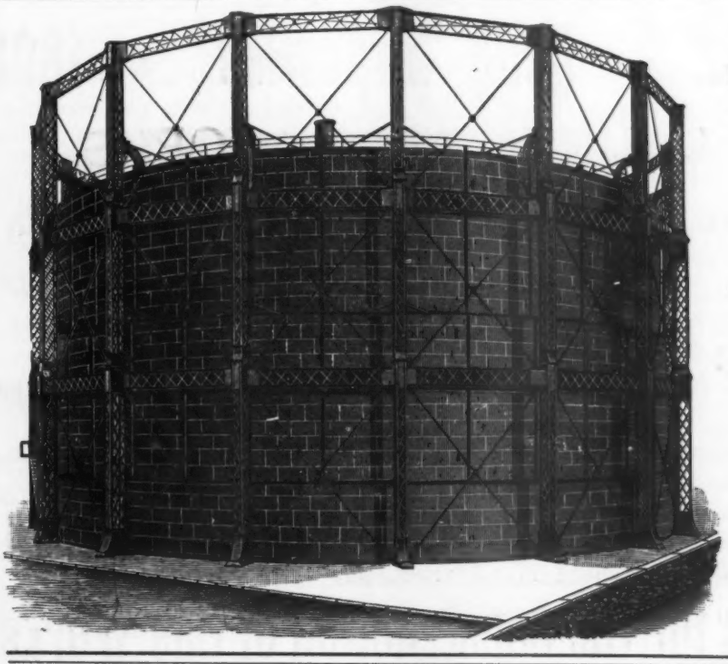

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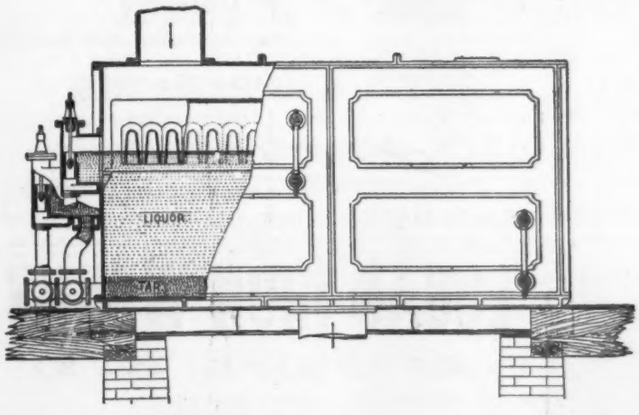

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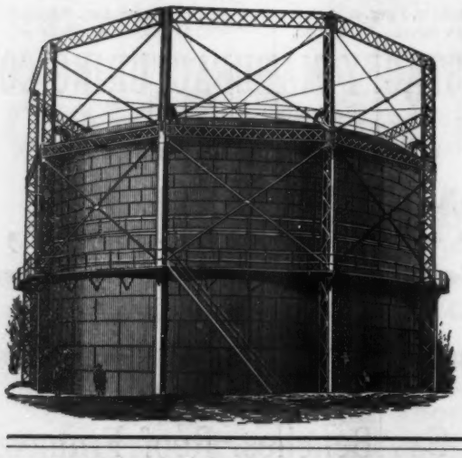

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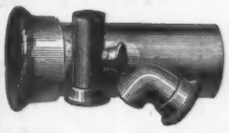

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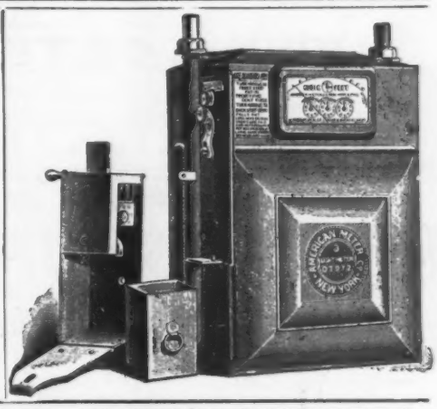

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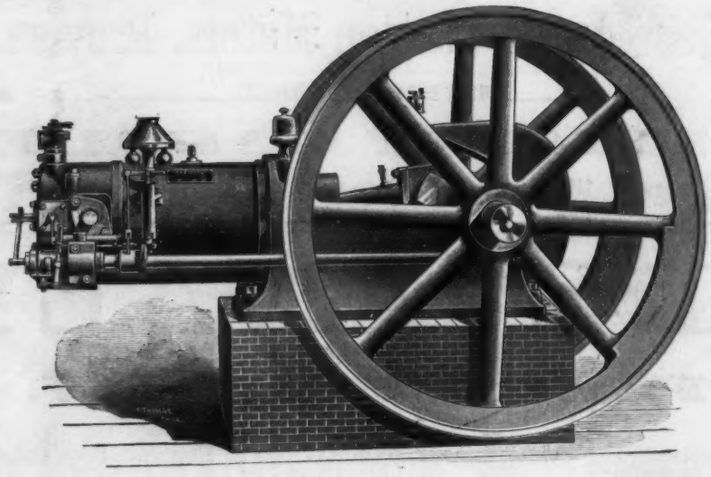

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